

Overview



For full technical specifications, refer to AppleCare Tech Specs: <http://support.apple.com/specs/>

Battery Safety Precautions



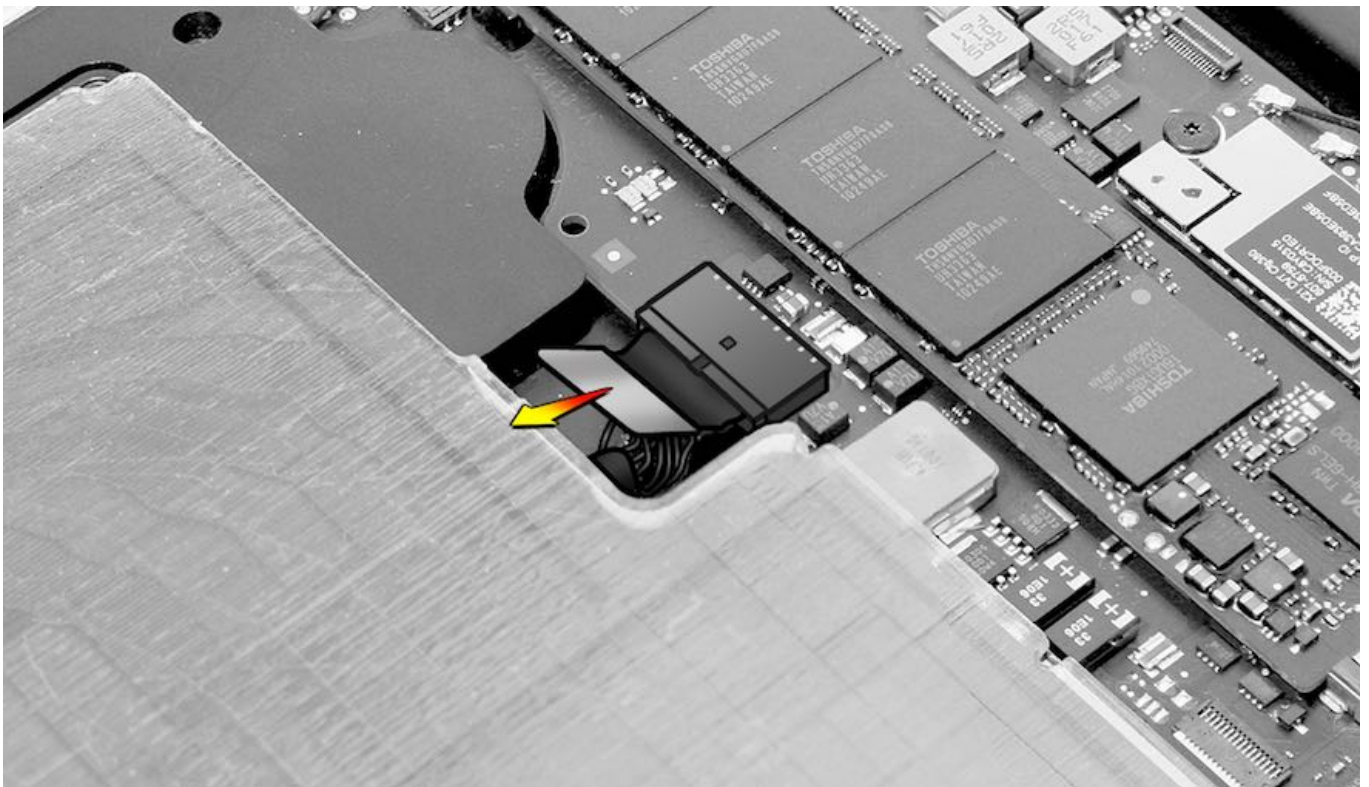
This computer contains a built-in Lithium-ion Polymer rechargeable battery pack that is serviceable by Apple Authorized Service Providers only. Tamper-resistant screws are employed to prevent users from attempting to remove the battery.

WARNING: Every time you remove the bottom case, attach the protective battery cover and disconnect the battery cable from the logic board.

WARNING:

- Batteries must be handled with utmost care.
- All work space must be free of foreign or sharp material and batteries should not be exposed to heat or open flame.
- Do not drop, stack, puncture, crush, flex, or apply unnecessary pressure to a battery, as this may result in damage.
- Damage to a battery may result in a potential fire hazard.

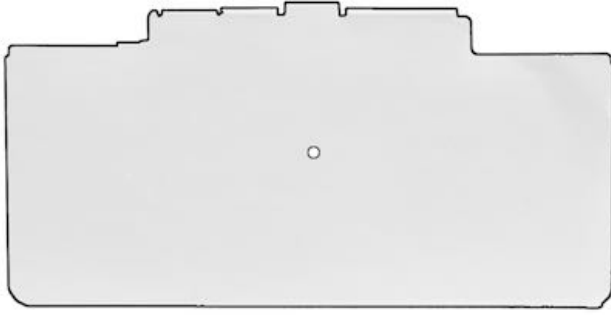
WARNING: Because the battery is internal and connected to the logic board by a cable, it **MUST BE DISCONNECTED** before performing service procedures. If you fail to do so, live current from the battery will short circuit the components and render the logic board and/or the eDP cable unusable.



Handling and Storage

Best Practices

The battery contains several soft battery cells. Do not press on the battery cells with your fingers, and do not handle the battery pack in any way that might apply any physical pressure to these cells.



- Always attach the appropriate battery cover to the battery immediately after removing the bottom case and before beginning battery removal or any other repair.
- Handle the covered battery by its edges only, with two hands at all times.
- Keep the battery cover on the battery at all times when the battery is out of the computer.
- Only remove the battery cover just before replacing the computer's bottom cover. Keep the battery cover on the battery at all other times.
- Do not drop a loose battery. If the battery is dropped, replace the battery.
- Only tighten the battery's screws finger tight; do not overtighten them by any amount, or irreparable damage to the battery pack can result.
- Do not twist or torque the battery, or irreparable damage to the battery can result.

Proper Sequence For Battery Removal

Battery removal steps are outlined below; detailed battery removal and replacement steps are described in the [battery](#) take apart section.

Important: When servicing the MacBook Air (13-inch, Late 2010) or MacBook Air (11-inch, Late 2010) and later computers, make sure you have a battery cover for each model, as the batteries are different sizes. Ensure a cover is placed on each battery whenever the bottom case is removed or if the battery is out of unit.

1. Remove bottom case.
2. Attach battery cover to exposed side of battery while it is still installed inside the computer. **Note:** You can remove the cover by carefully pulling up on the tabs, located across the top of the battery cover.
3. Disconnect battery connector from logic board.
4. Remove battery screws.
5. Carefully lift out covered battery with both hands and place on a smooth, hard, clean surface free of screws and other debris. Or, place battery in the box that the known-good battery shipped in.

Proper Sequence For Battery Replacement

Caution: Make sure no screws are stuck under the battery (inside the top case) or stuck to the inside cover of the bottom case. Check both areas before inserting battery and replacing bottom case.

1. Ensure battery cover is properly attached to the soft side of the battery before installing into computer. **Note:** The known-good battery should come with a cover already installed. Extra covers may be ordered in GSX.
2. Make sure top case interior is clean—free of any dust, dirt, loose screws, or other debris.
3. Carefully place known-good battery into position with both hands, aligning the screw holes in the battery frame with those of the computer's top case.
4. Install battery screws finger-tight; do not overtighten them by any amount or irreparable damage to the battery assembly can result.
5. Connect battery connector to logic board. Before replacing bottom case, remove battery cover and inspect battery for any dust, dirt, loose screws, or other debris.

Personal Protection

Use utmost care when handling the battery.

- Keep battery and computer away from heat and open flame. Store in a cool dry place.
- When servicing the computer, use the battery cover as directed.
- When handling a large container of batteries, steel-toed shoes are recommended.

WARNING: For complete training on battery safety and first-aid measures in case of accidental exposure, **make sure you**

read and understand this training article before servicing this computer: [OP24: Safely handling lithium batteries and lithium battery-powered devices](#).

Evaluating Battery Damage

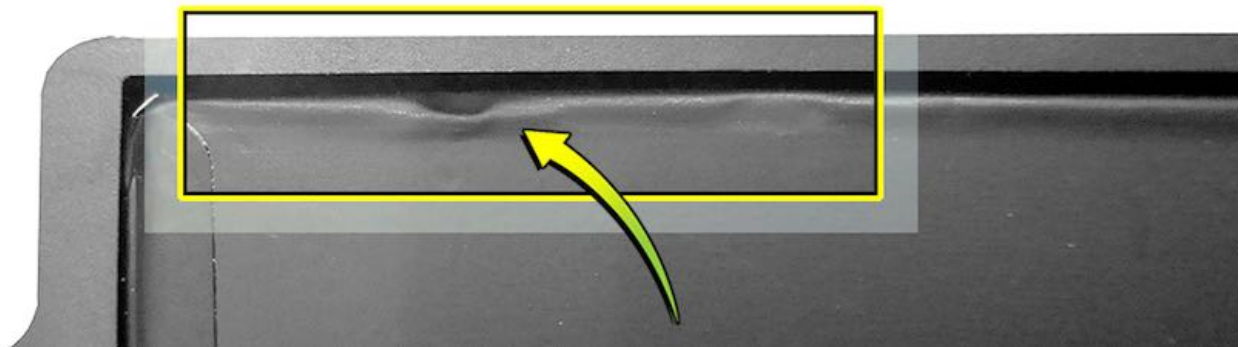
For more examples of cosmetic damage and complete directions on visual inspection, refer to article [OP693: SERVICE: MacBook Air \(Late 2010 and later\), MacBook Pro with Retina display computers: Visual battery inspection](#).

Use battery if:

- Minor dents (up to eight dents if 0.4 mm deep or less; up to five if 1.5 mm deep or less; up to three if 2.0 mm deep or less)

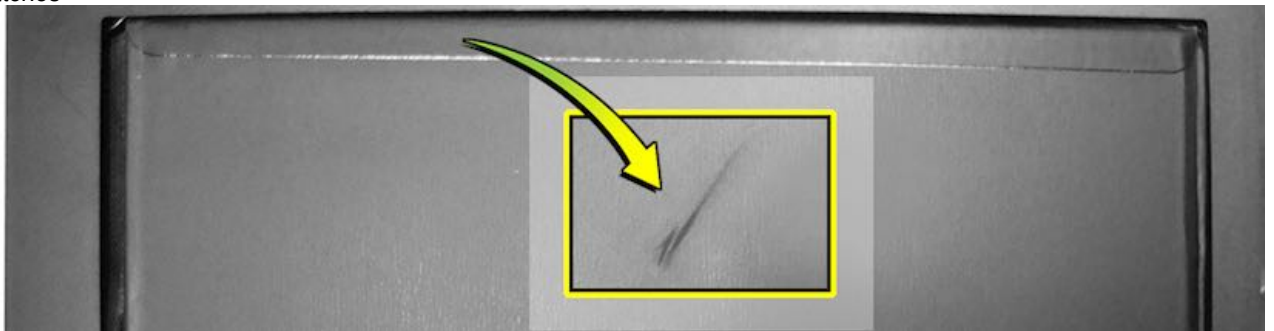


- Minor cell pack deformity (up to 2.0 mm total area)

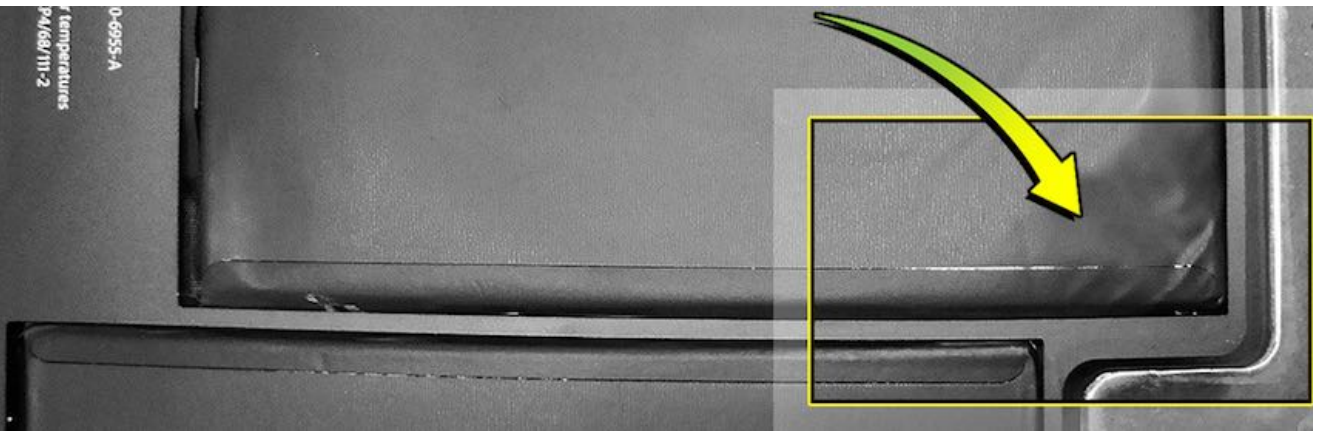


Return battery if:

- Scratches



- Swollen or wrinkled cell pack



Thunderbolt

Thunderbolt is a revolutionary I/O technology that supports high-resolution displays and high-performance data devices through a single compact port. It sets new standards for speed, flexibility, and simplicity. Read more at <http://www.apple.com/thunderbolt>.

Important: Thunderbolt requires up-to-date software and firmware to function properly. Obtain the latest updates via Software Update.

Caution: The Thunderbolt port is keyed for cable insertion in only one direction. Be sure to insert cables with the correct orientation. Do not use excessive force if the cable does not fit.

Keycap Replacement

Topic

Service packages of replacement keycaps are available for MacBook Air (Mid 2011, Mid 2012, Mid 2013, Early 2014, and Early 2015) models. The packages allow you to replace individual keycaps rather than the entire top case.

The following instructions explain how to remove and replace a keycap and scissor mechanism (plastic piece under keycap that secures keycap to top case) on MacBook Air (Mid 2011 or later) models. If a keycap needs replacement due to accidental damage, such as a liquid spill, refer to [OP14: Determining and quoting accidental damage for Mac portables](#).

To help determine keyboard localization or keycap placement, refer to [HT201794: How to identify keyboard localizations](#).

Notes:

- Keycap kits are available for International English, U.S. English, and Japanese version keyboards.
- A European Special Character Kit is available with British (B), German (D), French (F), Danish (DK), Italian (T), Spanish (E), and Swedish (S) specific keycap characters.
 - **Note:** To receive the proper keycaps to complete a single British, German, French, Danish, Italian, Spanish or Swedish keyboard, order both the European Special Character Kit **and** the ISO English keycap kit. Neither kit by itself contains all the keycaps necessary for a single localized keyboard.
- Always shut down the computer before replacing a keycap.

Identifying Keycaps and Scissors

Different types of keycap packages are offered based on computer model and keyboard type (Versions D and S).

Part number	Computer Model	Keyboard	Languages supported
923-0064	MacBook Air (11-inch, Mid 2011 and later)	Version D	ANSI English
923-0065	MacBook Air (13-inch, Mid 2011 and later)	Version D	ANSI English
923-0130	MacBook Air (13-inch, Mid 2012 and later)	Version S	ANSI English
B923-0065	MacBook Air (13-inch, Mid 2011 and later)	Version D	ISO English
B923-0130	MacBook Air (13-inch, Mid 2012 and later)	Version S	ISO English
J923-0065	MacBook Air (13-inch, Mid 2011 and later)	Version D	Japanese
J923-0130	MacBook Air (13-inch, Mid 2012 and later)	Version S	Japanese
ZM923-0065	MacBook Air (13-inch, Mid 2011 and later)	Version D	European Special Character Kit
ZM923-0130	MacBook Air (13-inch, Mid 2011 and later)	Version S	European Special Character Kit

The MacBook Air (13-inch, Mid 2012 and later) uses Version D and Version S keyboards. The scissors for both versions D and S keyboards function the same, but have a slightly different design. Be sure to match only Version D keycaps to Version D scissors/keyboards and Version S keycaps to Version S scissors/keyboards.

The photos below identify Version D and Version S scissors.

Version D scissors



Version S scissors



Keycap Map

The following illustrations summarize the differences in removing keycaps on the MacBook Air (Mid 2011 and later) keyboards. For detailed instructions, see the **Procedure** section below.

MacBook Air (11-inch, Mid 2011 and later)



MacBook Air (13-inch, Mid 2011 and later)



- **Yellow:** No stabilizer bar under key cap
- **Orange:** Hooked stabilizer bar under key cap (two hooked bars under Space Bar)
- **Blue:** Straight stabilizer bar under key cap
- **Stripes:**
 - **No Stripes:** Lift key from the lower corners
 - **Stripes:** Lift key from the upper corners

Procedure

Use the following steps to remove a defective keycap and replace it with a new keycap and scissors from the service keycap package. When replacing a keycap replace the scissors below it.

Because the design of the keycap and scissor mechanism differs depending on the shape of the key, the procedure is divided into four parts:

1. **Square keys and small rectangular keys** (for example, letters A–Z, numbers, punctuation, function keys, and arrow keys). These use one scissor mechanism beneath the key.
2. **Large rectangular keys** (for example, Shift, Delete, Return). These use one or two scissor mechanisms and one stabilizer bar (no stabilizer bar on bottom row, rectangular keys).
3. **Space bar**. This uses two scissor mechanisms and two metal stabilizer bars.
4. **Top row keys**. This only applies to MacBook Air (11-inch, Mid 2011, Mid 2012). This uses no scissor mechanism and one hooked metal stabilizer bar.

Note on illustrations: Most of the steps are illustrated with Version D scissors. However, the steps are the same for Version S scissors except where indicated.

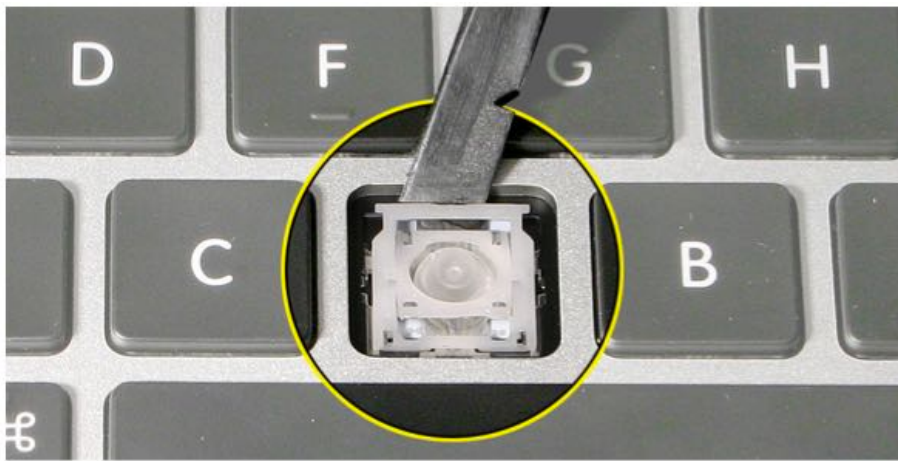
Important: Shut down the computer before replacing a keycap.

Removing and Replacing Square Keys and Small Rectangular Keys

1. Pry the key up from the lower edge—first at one corner and then at the other. Exception: Pry the Up Arrow keycap from the upper edge.

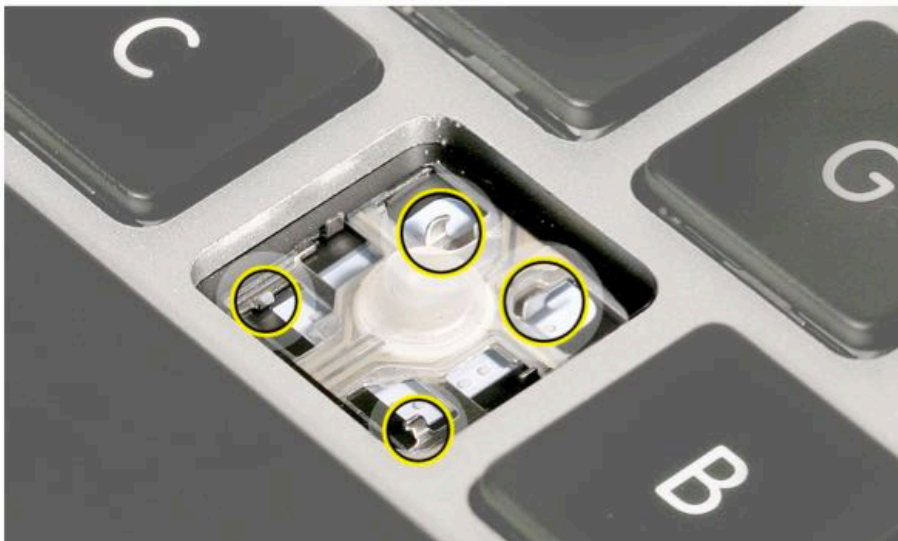


2. Pry and remove the scissor mechanism from the keycap well.



3. Check the rubber dome and raised metal areas inside the keycap well.

- When the rubber dome is pressed and released, it should spring back upright. If the rubber dome is off center or damaged, replace the top case.
- If the metal hook that holds the slider bar of the scissor mechanism is bent, try to bend it back to a uniform 90-degree angle. If it is bent or broken beyond repair, replace the top case.
- If the two metal ears are bent, use needle nose pliers to straighten them. If either or both ears are broken beyond repair, replace the top case.



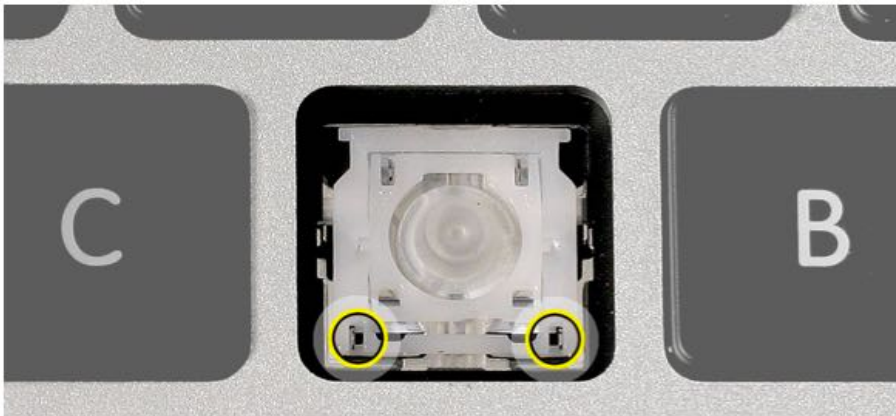
Note: To install the replacement scissor mechanism, you must first remove it from the replacement keycap.

4. Position the pointed end of a black stick under both plastic layers on the pin side of the scissors. Pry up and remove the scissors from the keycap.

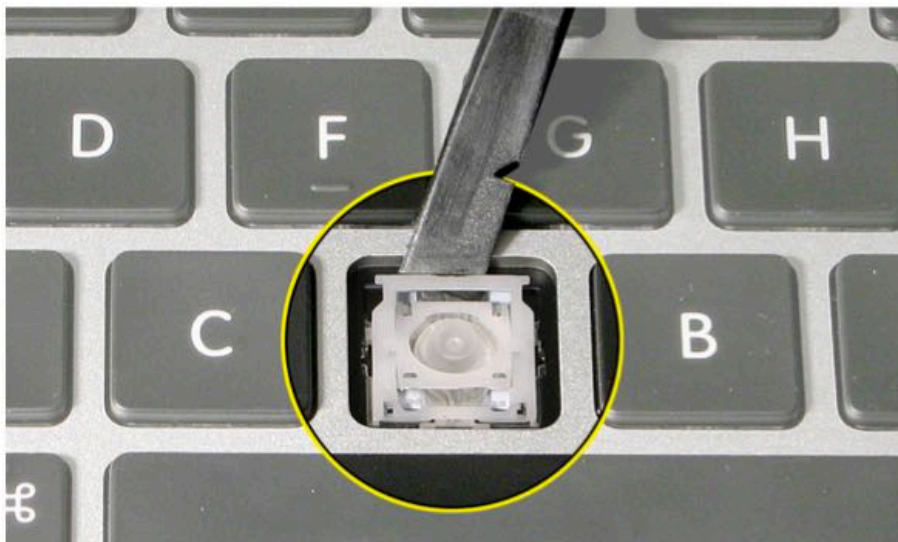


5. To install the replacement scissors in the keycap well, position the scissors so that the smooth side faces up. Holding the scissors closed, fit the two small square openings in the scissors onto the two metal hooks at the lower edge of the keycap well.

6. Press and slide the scissors up until the two rectangular openings in the scissors fit over the two metal hooks at the upper edge of the keycap well.



7. Use a black stick to raise and lower the scissor mechanism to make sure it moves freely.



8. Slide the upper edge of the keycap into the keycap well. Then press down on the top of the key until you feel it snap into place.



9. Check the key from all angles to make sure it is uniformly flat. Press and release the key repeatedly to verify that it springs back each time.

Removing and Replacing Large Rectangular Keys (except Space bar)

Note: All rectangular keys with a stabilizer bar use one hooked bar, with the exception of the Command key, which uses a straight bar.

1. Pry the Space bar from the lower two corners, and lift it a short distance.
2. Detach the stabilizer bar from the left and right openings in the two metal ears in the keycap well.



3. Remove the original scissors and install the replacement scissors. Refer to steps 2–6 under [Removing and Replacing Square Keys/Small Rectangular Keys](#).
4. With the stabilizer bar installed in the replacement keycap, rotate the stabilizer bar approximately 90 degrees out from the key. Then insert the ends of the bar into the openings in the metal ears in the keycap well.
5. Lower the key over the keycap well and press down on the top of the key until it snaps into place.
6. Check the key from all angles to make sure it is uniformly flat. Press and release the key repeatedly to verify that it springs back each time.

Removing and Replacing Space Bar

1. Pry the Space bar from the lower two corners, and lift it a short distance.



2. Using a black stick, separate the lower stabilizer bar from the keycap.



3. With the lower edge loosened, pry the Space bar from the upper edge. Use a black stick, if necessary, to tilt up and remove the keycap.

Note: To fully remove the keycap, you may need to pry it from the top stabilizer bar. Be sure to remove both stabilizer bars from the keycap well.

4. Remove the original scissors and install the replacement scissors. Refer to steps 2–7 under [Removing and Replacing Square Keys/Small Rectangular Keys](#).

Version D Space Bar Replacement

1. Orient the replacement Space bar so that the slider hooks on the underside of the key are at the lower edge of the key.

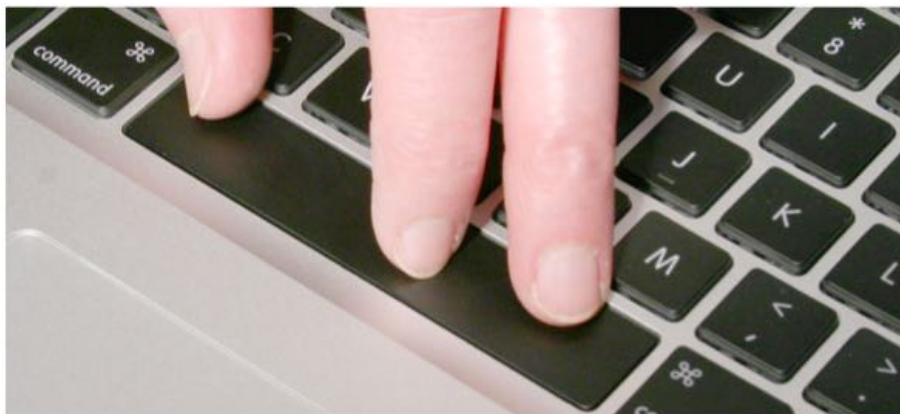


2. Rotate the lower stabilizer bar on the Space bar approximately 90 degrees out from the key and insert the ends of the bar into the two lower metal ears in the keycap well.



3. Insert the ends of the upper stabilizer bar into the two upper metal ears in the keycap well and lower the keycap over the well.

4. Press and slide your fingers along the Space bar until you hear the clips on the top and bottom edges snap into place.



5. Check the key from all angles to make sure it is uniformly flat. Press and release one corner of the key. If the key is installed correctly, the opposite corner should respond at the same level (not tilted higher or lower).

Version S Space Bar Replacement

1. Orient the replacement Space bar so that the slider hooks on the underside of the key are at the lower edge of the key.



2. Using a black stick, remove the top stabilizer bar.



3. Hook the top stabilizer bar into the upper two metal ears in the keycap well.



4. Rotate the lower stabilizer bar on the Space bar approximately 90 degrees out from the key and hook the ends of the bar into the two lower metal ears in the keycap well.

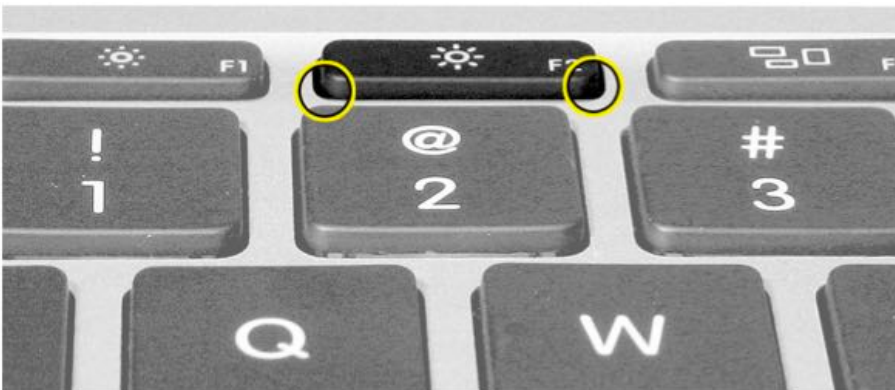


5. Lower the upper edge of the keycap down into the keycap well.

6. Press and slide your fingers along the Space bar until you hear the clips on the top and bottom edges snap into place.

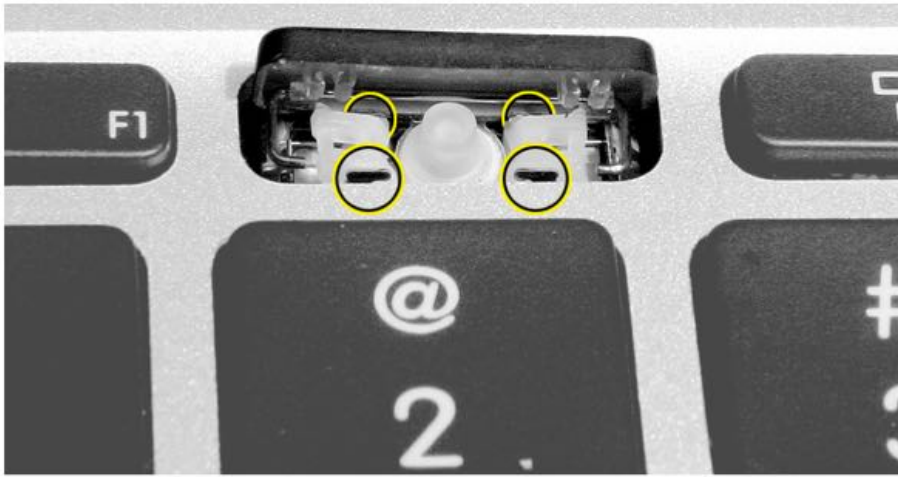
Removing and Replacing Top row keys

1. Remove a top row key by prying the bottom corners.

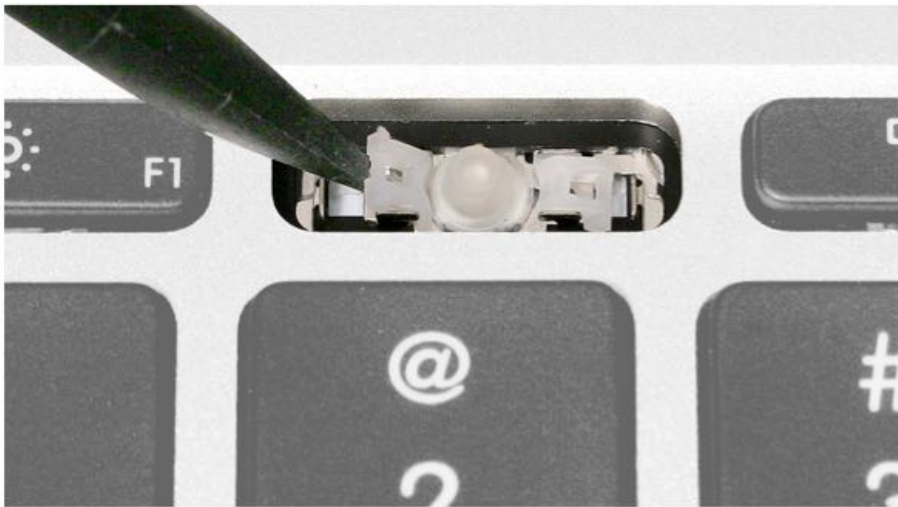


2. Check the rubber dome and raised metal hooks inside the keycap well.

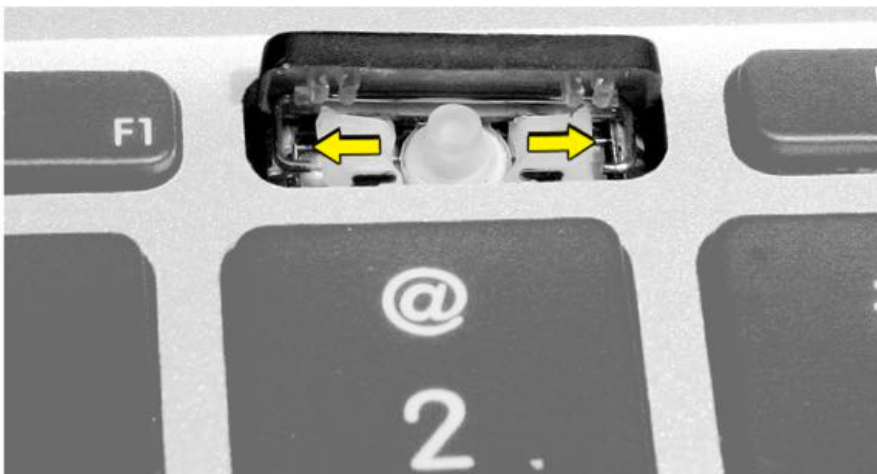
- When you press and release the rubber dome it should spring back upright. If the rubber dome is off center or damaged replace the top case.
- If any of the metal hooks that hold the plastic pieces are bent, try to bend them back to a uniform 90-degree angle. If they are bent or broken beyond repair, replace the top case.



3. Using the pointed tip of a black stick, remove the two plastic squares by tilting them up and sliding them toward the rubber dome.



4. To install the replacement squares in the keycap well, position them smooth side up, and lower them into the keycap well. Slide them away from the dome until the two metal hooks catch the plastic pins.



5. Press the stabilizer bar into the two clips inside the top of the keycap.



6. Fold the stabilizer bar flush inside the keycap.

7. Center the keycap into the keycap well, and then press down on the top of the key until you feel it snap in place.



Serial Number Locations

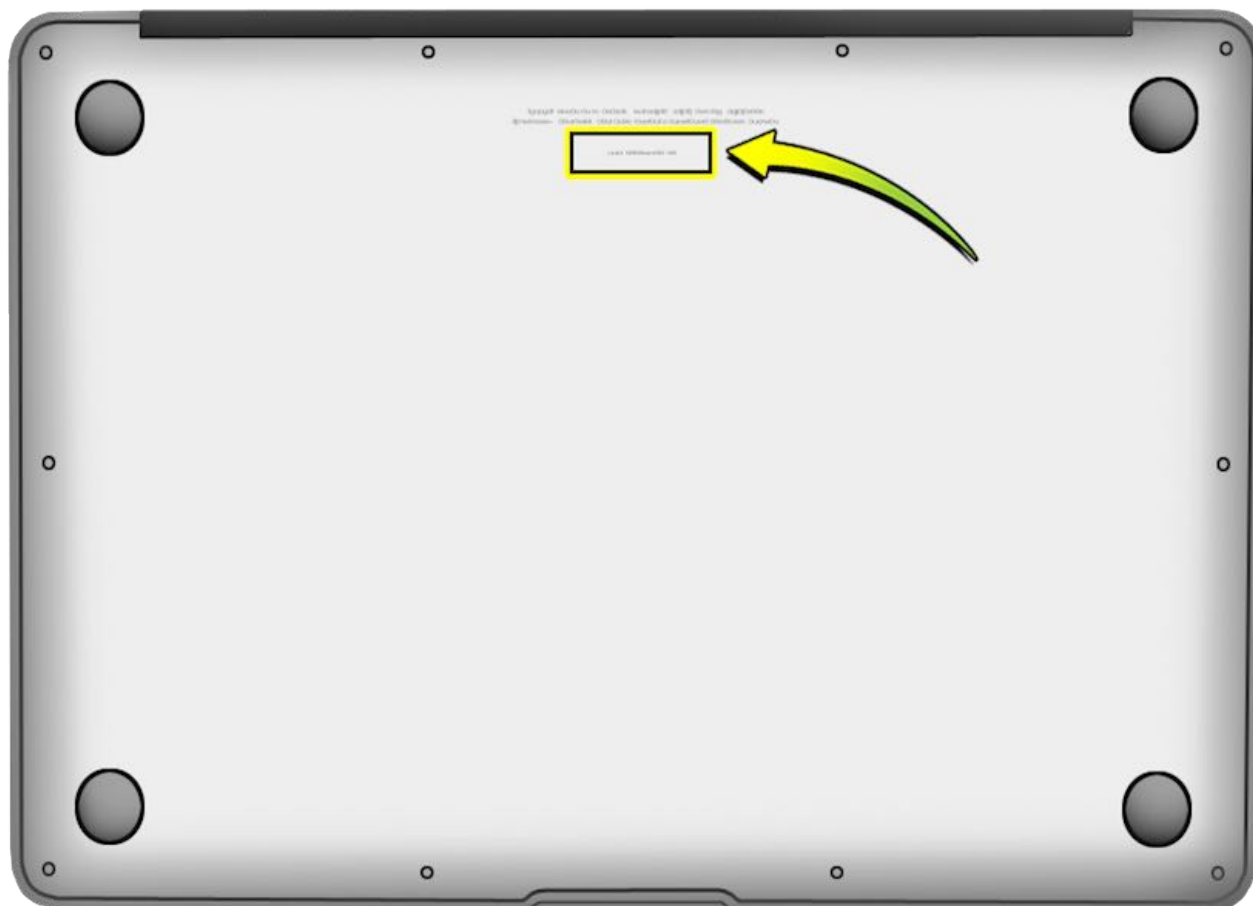
Serial Number Locations

Note: Barcode readers can be used to read serial numbers inside the computer.

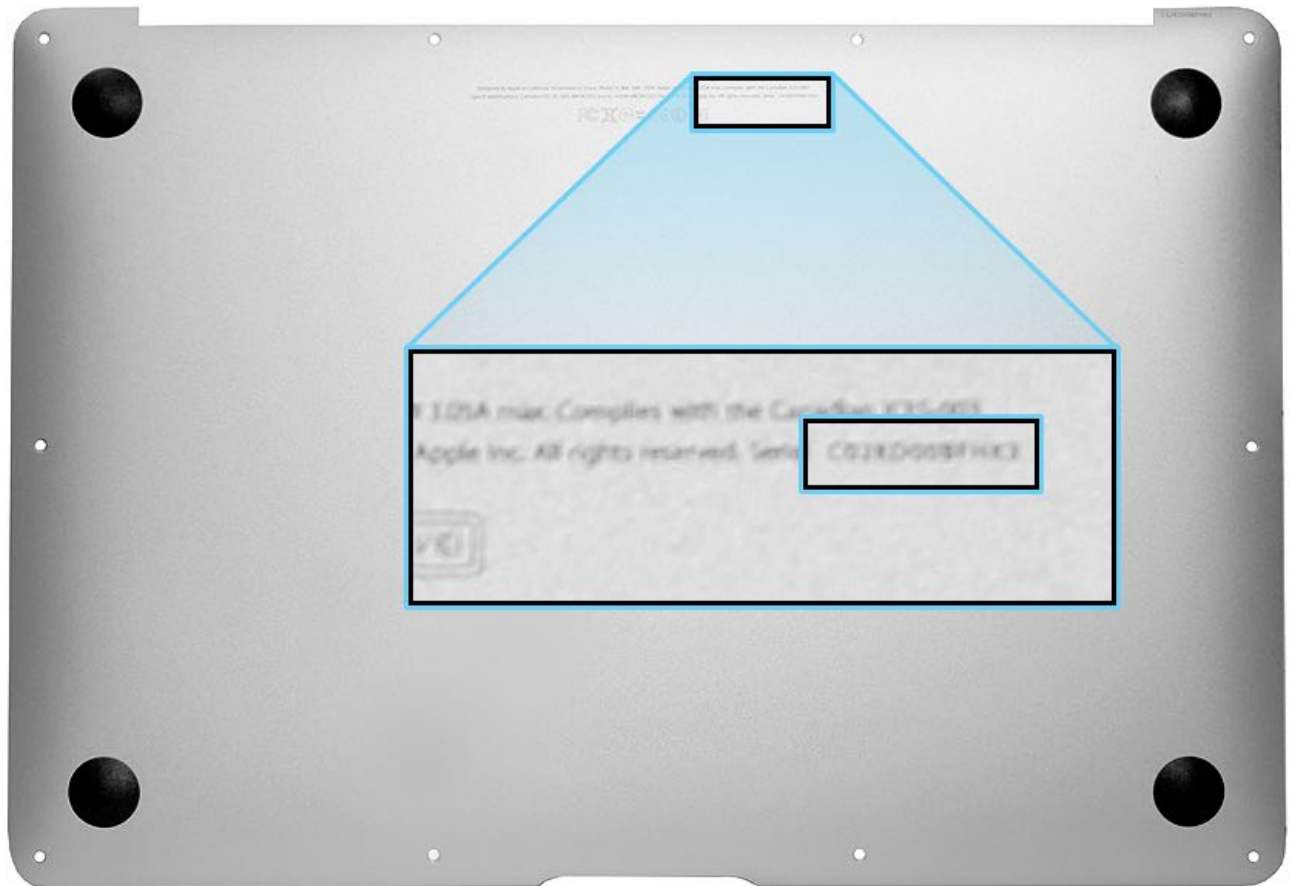
System Serial Number

Turn over computer to see serial number etched on bottom case near hinge.

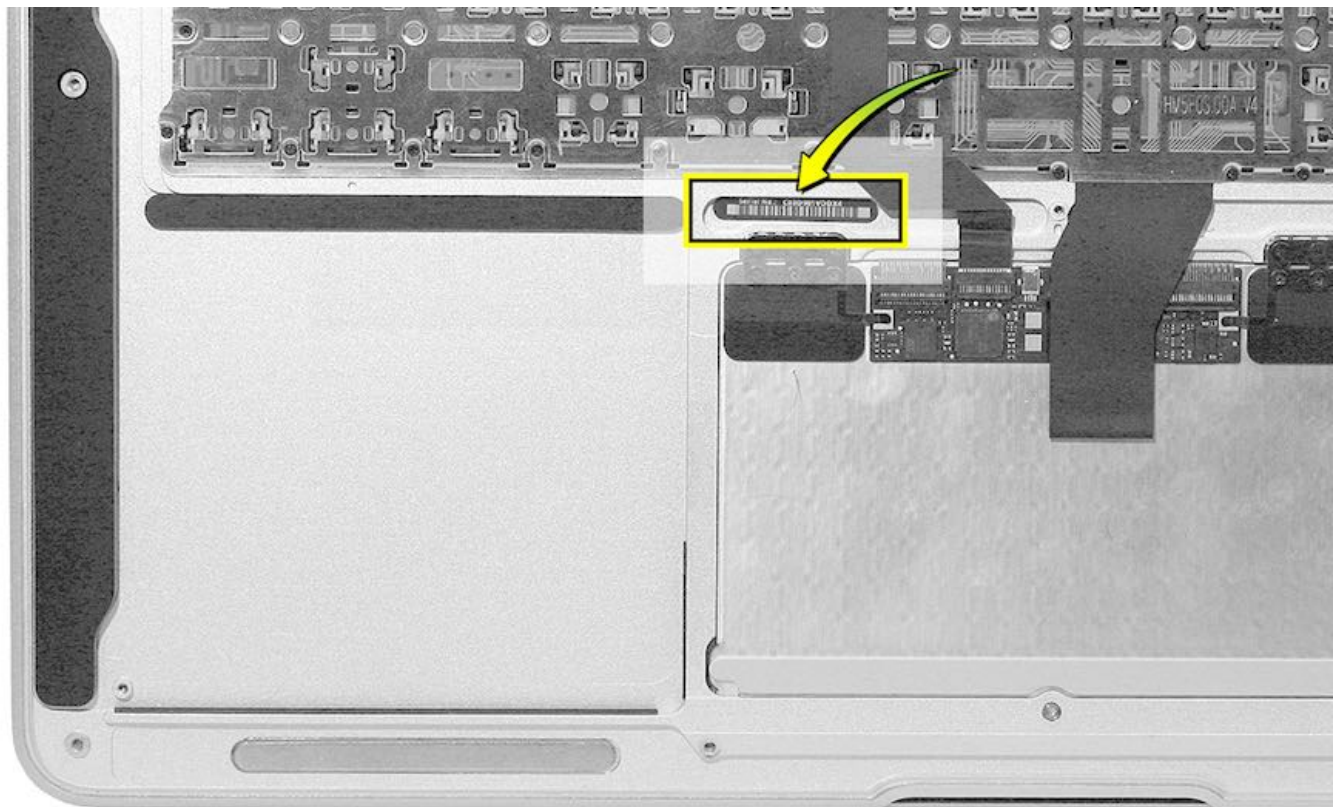
MacBook Air (13-inch, Late 2010, Mid 2011, and Mid 2012)



MacBook Air (13-inch, Mid 2013, Early 2014, Early 2015, 2017)

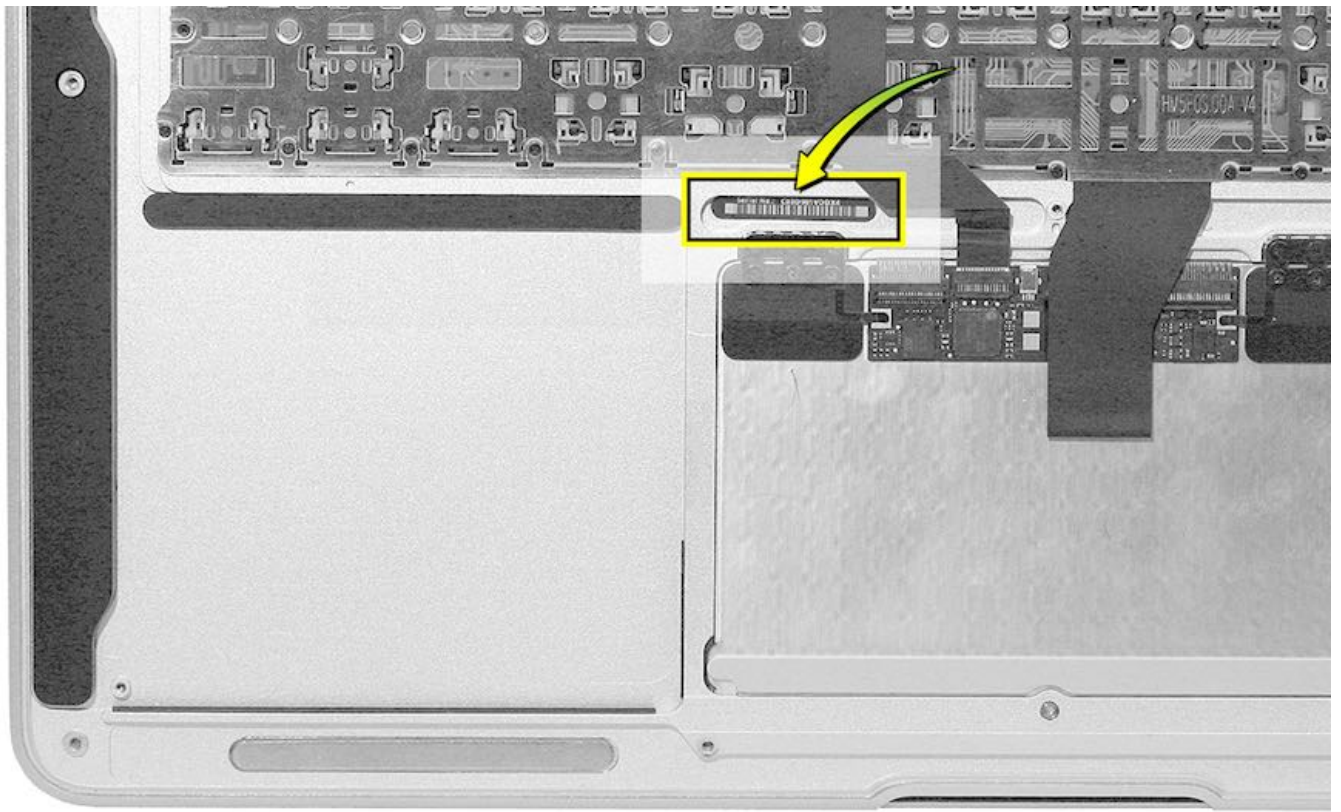


With battery removed, see system serial number label on top case.

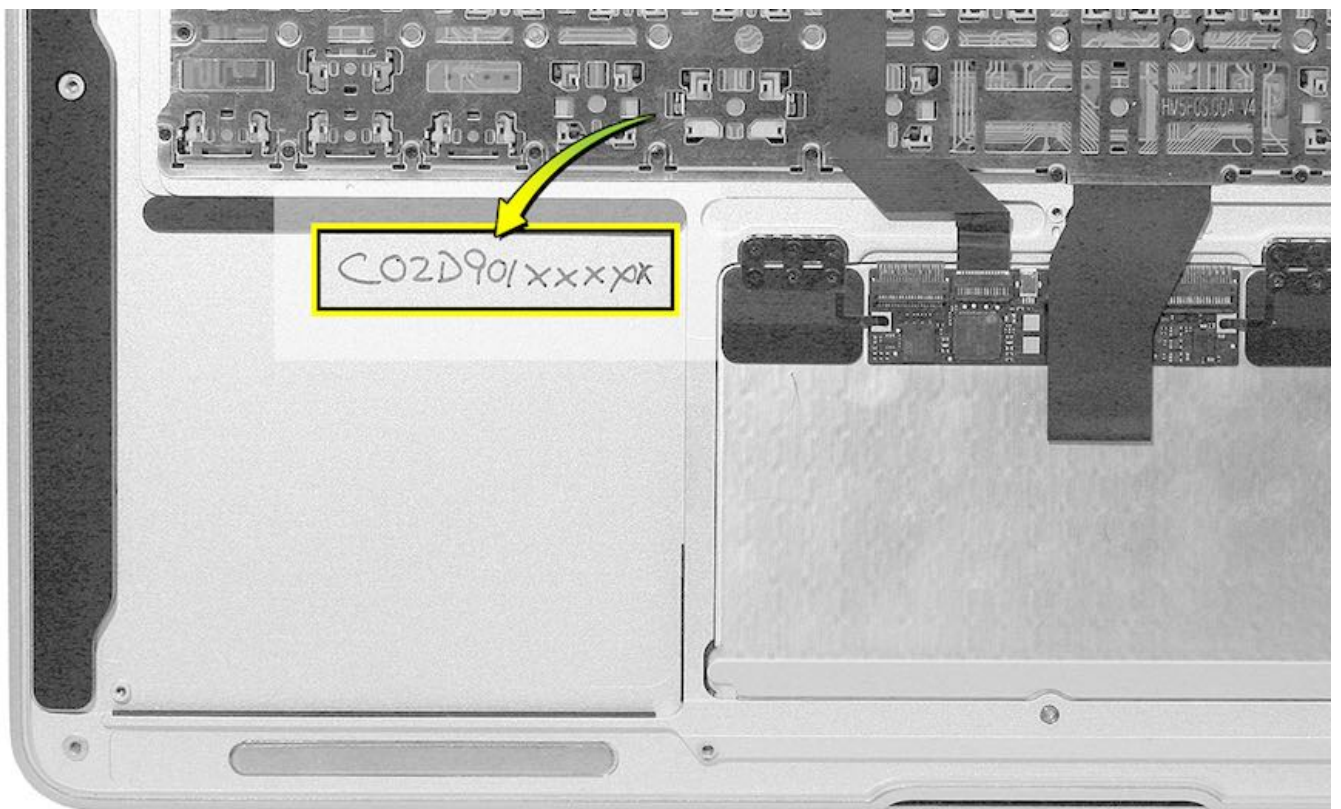


Transferring the System Serial Number

When replacing top case, retain user's top case until repair is complete. Before installing replacement, attach system serial number label in space above trackpad.

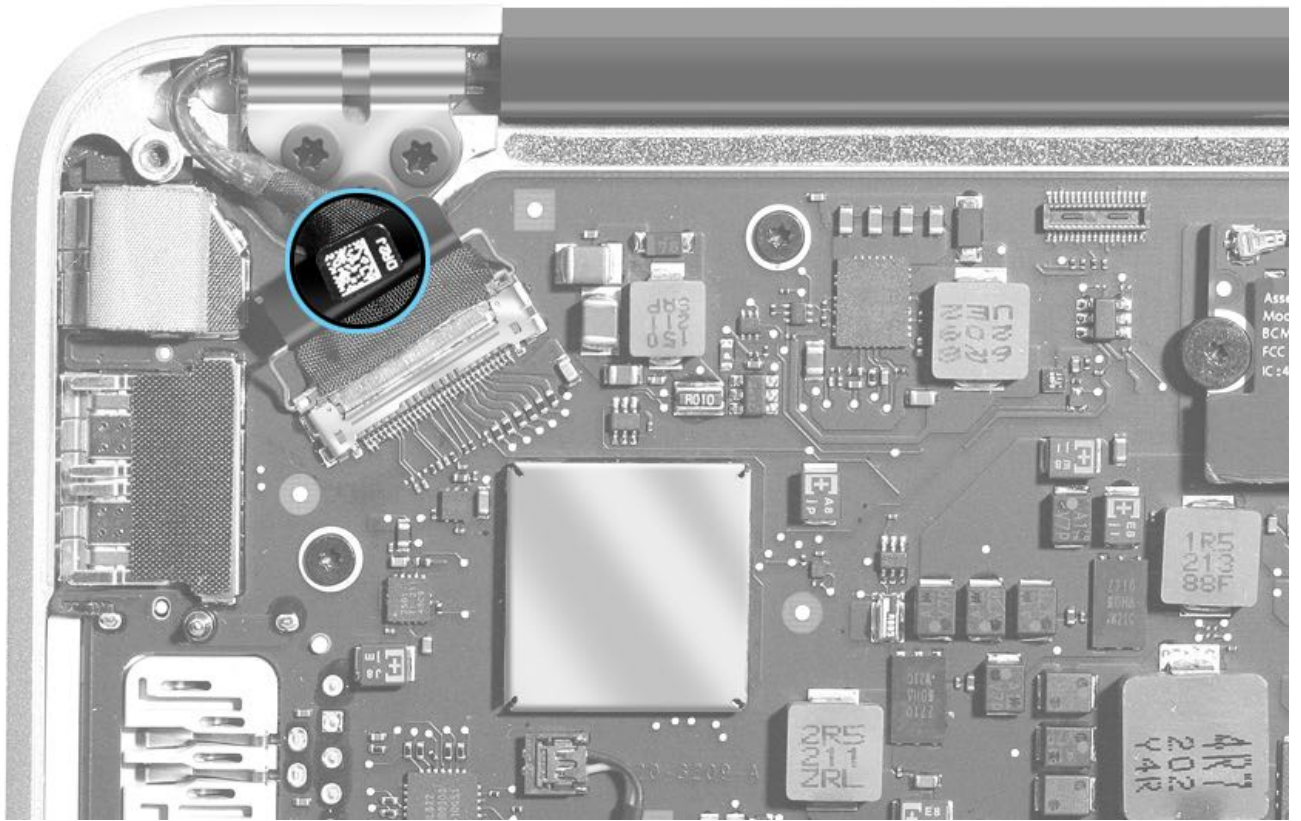


If serial number label cannot be reused, use a fine-tipped permanent marker to write serial number on inside of top case.



Display Clamshell Serial Number (Mid 2012, Mid 2013, Early 2014, Early 2015, 2017)

MacBook Air (13-inch, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017) includes a 2D bar code of display clamshell serial number on underside of the pull tab for eDP cable. Bar code links display clamshell to system serial number.



Visual/Mechanical Inspection (VMI) Guide for Mac Computers - Table of Contents

Visual/Mechanical Inspection (VMI) Guide for Mac Computers - Table of Contents

- [Mac Displays](#)
- [Liquid Damage](#)
- [Power Adapters](#)
- [USB-C Cables](#)

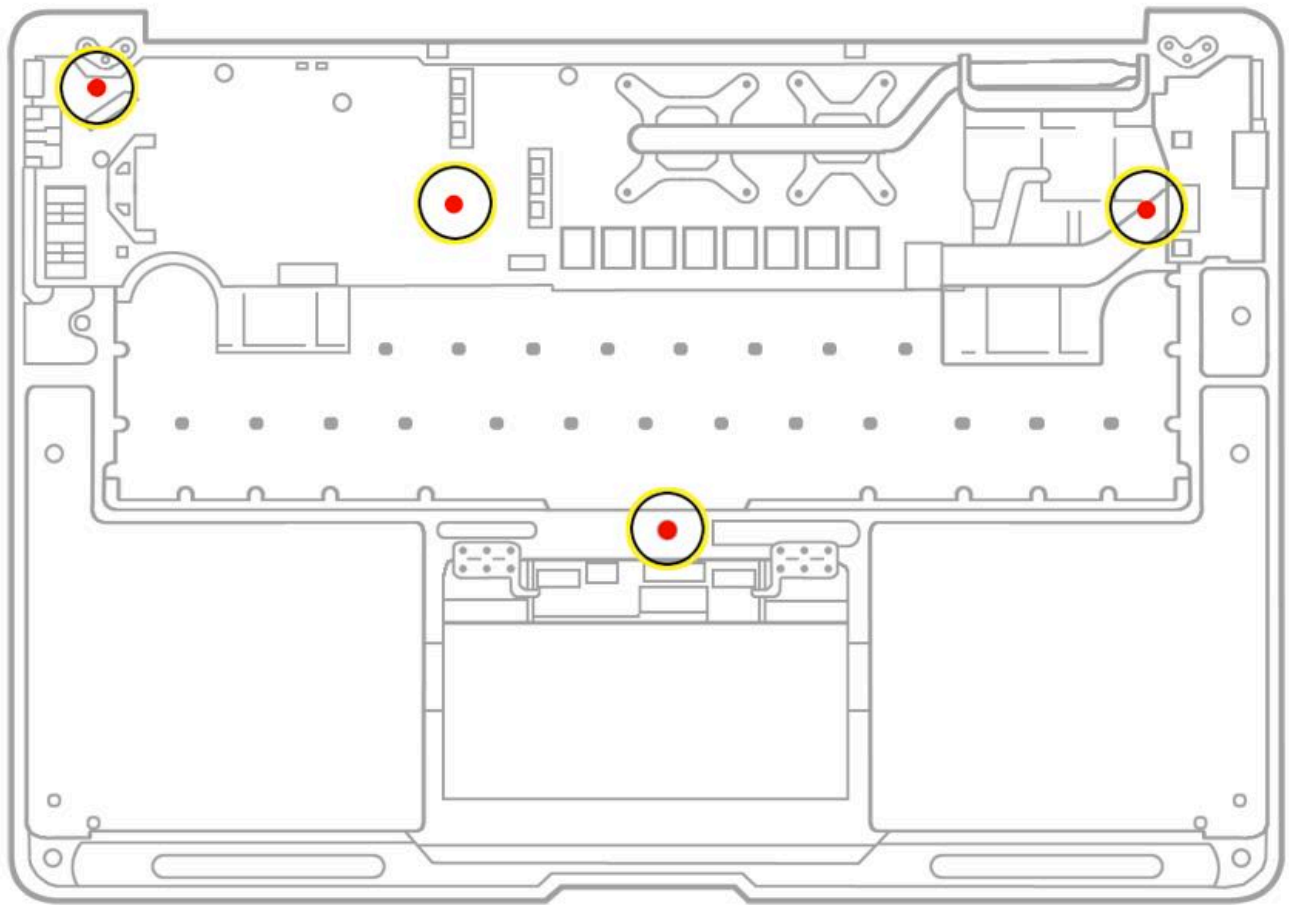
Liquid Contact Indicators

Liquid Contact Indicators for MacBook Air (13-inch, Late 2010, Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017)

To help discover accidental damage to the computer, the top case includes spill sensors called liquid contact indicators (LCI). The sensors are visible only when the bottom case and most of the modules have been removed. Normally represented by small white dots, the LCIs turn red when they have come in contact with liquid, such as an accidental spill.

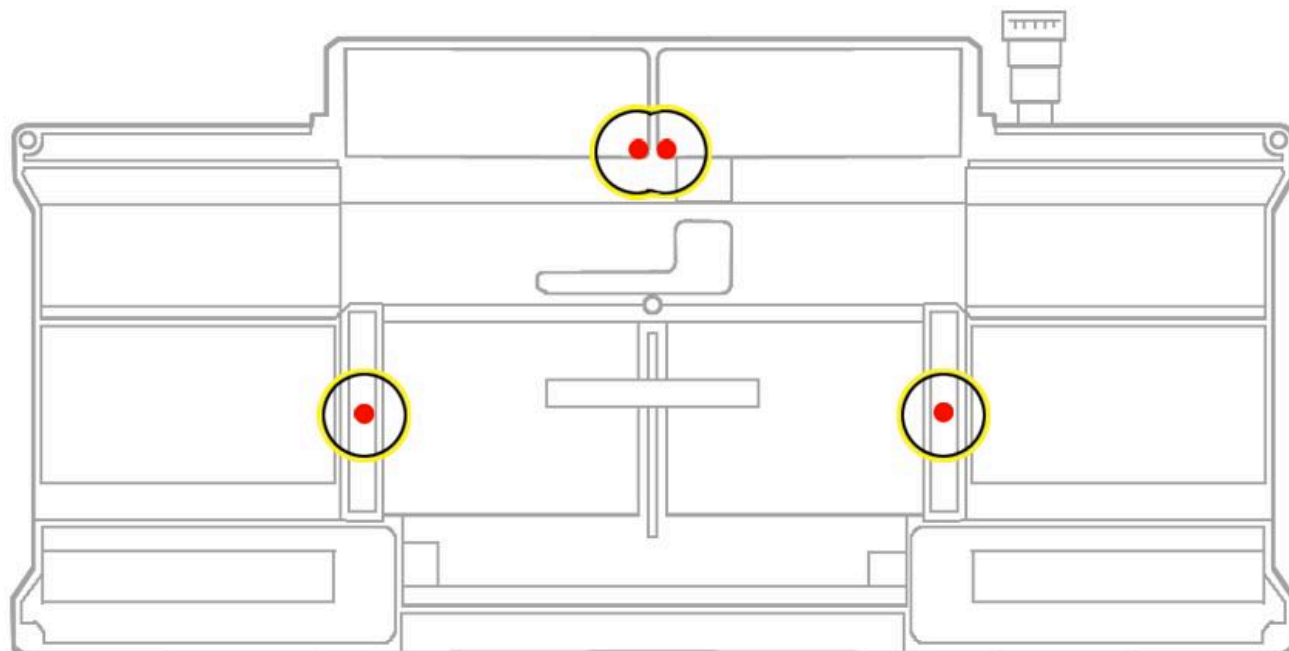
For more information, refer to article [HT204769: Mac computers: About liquid contact indicators \(LCIs\) and warranty coverage](#)

The following image shows the general location of the LCIs in this computer. For LCIs that are not readily visible with the bottom case removed, check the same area under cables or on the other side of modules.



Battery Liquid Contact Indicators

This image shows the location of LCIs on the underside of the battery module.



LCD Pixel Anomalies

When displaying a single color over the screen area, the LCD panel might show one or more pixels that are not properly lit.

LCD technology uses rows and columns of addressable points (pixels) that render text and images on the screen. Each pixel has three separate subpixels—red, green, and blue—that allow an image to render in full color. Each subpixel has a corresponding transistor responsible for turning that subpixel on and off.

Depending on the display size, there can be thousands or millions of subpixels on the LCD panel. For example, the LCD panel used in the iMac (27-inch, Late 2013) has a display resolution of 2560 by 1440, which means that there are 3.7 million pixels. Each pixel is made up of a red, a green, and a blue subpixel, resulting in over 11 million individual picture elements on the 27-inch display. Occasionally, a transistor may not work perfectly, which results in the affected subpixel remaining off (dark) or on (bright). With the millions of subpixels on a display, it is possible to have a low number of such transistors on an LCD. In some cases, a small piece of dust or other foreign material may appear to be a pixel anomaly. Apple strives to use the highest quality LCD panels in its products; however, pixel anomalies can occur in a small percentage of panels.

In some cases, pixel anomalies are caused by a piece of foreign material that is trapped somewhere inside the display or on the front surface of the display or glass panel. Foreign material is typically irregular in shape and is usually most noticeable when viewed against a white background.

- For any computer, foreign material on the outer surface of the display or glass panel can be easily removed using a lint-free cloth.
- For iMacs only, foreign material trapped between the glass panel and display should be removed by an Apple Authorized Service Provider or Apple Retail Store.
- For any computer, foreign material trapped inside the display can only be resolved by replacing the entire display assembly.

To determine if the display has an acceptable number of pixel anomalies, see the appropriate article:

- [HT202025: About LCD display pixel anomalies for Apple products released in 2010 and later](#)
- [HT201613: About LCD display pixel anomalies for Apple products released before 2010](#)

General Troubleshooting

Update Software and Firmware

Important: Before you begin troubleshooting, ensure the correct version of macOS is installed, and check for and apply the latest software and firmware updates. Computers sometimes exhibit symptoms that indicate the wrong version of macOS system software is installed. Check article [HT204319: macOS versions and builds included with Mac computers](#) to make sure system build is correct for this computer model.

Firmware is the name given to software that is written into memory circuits such as flash memory, that will hold the software code indefinitely, even when power is removed from the hardware. Firmware on Intel Mac computers is designed to be updated if necessary by running the macOS Software Update check (available in the Apple () menu) while the computer is connected to the Internet.

For more information about firmware updates, refer to article [HT201518: About EFI and SMC firmware updates for Intel-based Mac computers](#).

Troubleshooting Techniques

For more information, go to [ATLAS](#) and enter “troubleshooting” in the search field.

Hardware vs. Software

To isolate a hardware issue from a software issue, refer to article [HT203161: Isolating issues in macOS](#).

To troubleshoot a software issue, refer to the following articles:

- [HT201516: How to troubleshoot a software issue](#)
- [HT201861: About incompatible software on your Mac](#)
- [HT204323: If a flashing question mark appears when you start your Mac](#)
- [HT204904: How to reinstall macOS](#)
- [HT202574: Mac mini \(Late 2012 and later\), iMac \(Late 2012 and later\): About Fusion Drive](#)

Quick Check Procedures

Resetting the System Management Controller (SMC)

The System Management Controller (SMC) is a chip on the logic board that controls all power functions. If the computer is experiencing any power issue, such as not starting up, not displaying video, sleep issues, or fan noise issues, resetting SMC may resolve it.

For more information and instructions to reset the SMC on different computer models, refer to article [HT201295: Reset the System Management Controller \(SMC\) on your Mac](#).

Note for iMacs: If the power button is pressed while inserting the power cord, the iMac will enter a mode in which the fans run at full speed. For more information, refer to article [HT204463: iMac: Fans run at full speed after computer turns on](#).

Resetting Non-Volatile RAM (NVRAM)

NVRAM stores certain system and device settings in a location that macOS can access quickly. Exactly which settings are stored in the computer's NVRAM varies depending on the type of computer as well as the types of devices and drives connected. To reset NVRAM:

1. Shut down the computer.
2. Locate the following keys on the keyboard: Command, Option (Alt), P, and R. You will need to hold these keys down simultaneously in Step 4.
3. Press power button.
4. Immediately press and hold Command-Option-P-R keys.
Important: You must press this key combination before the gray screen appears.
5. Hold down keys until computer restarts, and you hear startup chime a second time.
Note: For MacBook Pro (Late 2016 and 2017) and MacBook (Retina, 12-inch, 2017), hold down keys for at least 20 seconds. There is no startup chime.
6. Release keys.

Note: After resetting NVRAM, you might need to reconfigure settings for speaker volume, screen resolution, startup disk selection, and time zone information.

For more information, refer to article [HT204063: How to Reset NVRAM on your Mac](#).

Starting Up in Safe Mode

Safe Mode (sometimes called Safe Boot) is a way to start up a Mac so that it performs certain checks and prevents some software from automatically loading or opening. These changes can help resolve or isolate certain issues on the startup disk.

Follow these steps to start up into Safe Mode:

1. Be sure the computer is shut down.
2. Press the power button.
3. Press and hold the Shift key.
Note: The Shift key should be pressed as soon as possible after the power button is pressed.
4. Release the Shift key when you see the Apple logo appear on the screen. After the Apple logo appears, it may take longer than usual to reach the login screen. This is because the computer is performing a directory check as part of Safe Mode.
5. To leave Safe Mode, restart the computer without pressing any keys during startup.

For more information, refer to article [HT201262: Use Safe Mode to isolate issues with your Mac](#).

Sleep Status Tips

The following portable Mac models do not have a sleep LED:

- MacBook Air (Late 2010 and later)
- MacBook Pro (Retina, Mid 2012 to Mid 2015)

To troubleshoot without a sleep LED:

- Connect a USB device that has a power-on or activity LED. As power is restored to the USB and the system wakes from sleep, the LED lights up.
- Press Caps Lock key multiple times to wake the computer from sleep.
- Open display and press an alphanumeric key to wake the computer from sleep.
- A computer that has been asleep for an extended period can consume the remaining charge of the battery. Restore power to the computer with known-good power adapter, and check that the MagSafe indicator light shows an in-progress battery charge. The computer will boot from a hibernation file and start up from where it left off.
- Resetting SMC instantly shuts down the computer, with some side effects:
 - If the computer is in sleep mode, it will reboot from a hibernation file.
 - If the computer is booted to OS X or macOS during the SMC reset, data from open applications can be lost.
 - If the computer is already shut down, there will be no side effects.

Note: Look for the MagSafe indicator light to momentarily switch from off to green as SMC is reset and re-establishes communication with power adapter, then change from green to orange if the battery needs a charge.

Diagnostic Software

	Apple Service Diagnostic (ASD)	Apple Hardware Test (AHT)	Apple Diagnostics
MacBook Air (13-inch, Late 2010)	3S142	3A204	
MacBook Air (13-inch, Mid 2011)	3S146	3A223	
MacBook Air (13-inch, Mid 2012)	3S155	3A244	
MacBook Air (13-inch, Mid 2013)	3S156		v1.0 or later
MacBook Air (13-inch, Early 2014)	3S156		v1.0.6 or later

Apple Service Toolkit (AST)

AST is a suite of diagnostic tools that checks Intel-based Mac hardware components, and provides detailed diagnostic logs for review. AST runs on a local server, managing multiple Ethernet clients via NetBoot.

For more information, refer to Apple Support articles:

- [OP476: Latest Apple Service Toolkit download links and documentation](#)
- [TP586: AST Reference Guide](#)

Mac Resource Inspector (MRI)

MRI, which is part of AST, is a quick triage tool that checks for the presence of hardware and reports sensor readings. Sensors are located on a variety of parts, including cables, fans, storage devices, power supply, display panel, and logic board. Use MRI to help isolate failures and avoid unnecessary part replacements. MRI complements ASD, which is a more in-depth repair verification tool.

Note: If all AST checks pass and a component is still suspected of fault, then verify with other diagnostic tools.

Cooling System Diagnostic (CSD)

CSD evaluates thermal sensors, fans, and heat sinks in late model MacBook Pro, MacBook Air, and iMac computers. It either confirms correct operation or helps diagnose service issues. CSD is useful when assisting users with questions about fan noise. This 30-40 minute test, designed for use at the repair bench, fully checks thermal efficiencies in MacBook Air (13-inch, Late 2010) and later models. This test requires a USB ambient temperature sensor, available for order via GSX (part number 922 - 9911).

Trackpad Keyboard Mapper

The Trackpad Keyboard Mapper pairs the trackpad and keyboard of MacBook Air (Mid 2013 and Early 2014) models. To ensure correct keyboard behavior, you must run this tool whenever you replace a Mid 2013 or Early 2014 trackpad. For more information, refer to [TP1016: AST Reference Guide: Using the Trackpad Keyboard Mapper](#).

Diagnostic Software

Apple Service Toolkit 2 (AST 2)

AST 2 is a cloud-based diagnostic system to help technicians triage and verify repairs for iOS devices and Mac computers released in June 2014 and later, except for MacBook Pro (Retina, Mid 2014). With AST 2, technicians initiate diagnostics wirelessly on a user's device using a Diagnostic Console (a web application on a Mac or iPad). Technicians are also able to view diagnostic results on the Diagnostic Console.

For more information, refer to:

- [OP476: Latest Apple Service Toolkit download links and documentation](#)
- [TP1105: AST 2 for Mac Reference Guide - Table of Contents](#)
- [TP1118: AST 2 for Mac Reference Guide - Table of Contents \(Retail\)](#)

Apple Diagnostics

Apple Diagnostics is a customer-facing software tool that is built-in to all Mac computers released in June 2013 and later.

For more information, refer to:

- [HT202731: How to use Apple Diagnostics on your Mac](#)
- [HT203747: Apple Diagnostics: Reference codes](#)

Thermal and Electrical Sensors

Reference the tables below for MacBook Air (11-inch and 13-inch, Mid 2013, Early 2014, Early 2015) and MacBook Air (13-inch, 2017) sensor information.

Thermal Sensors

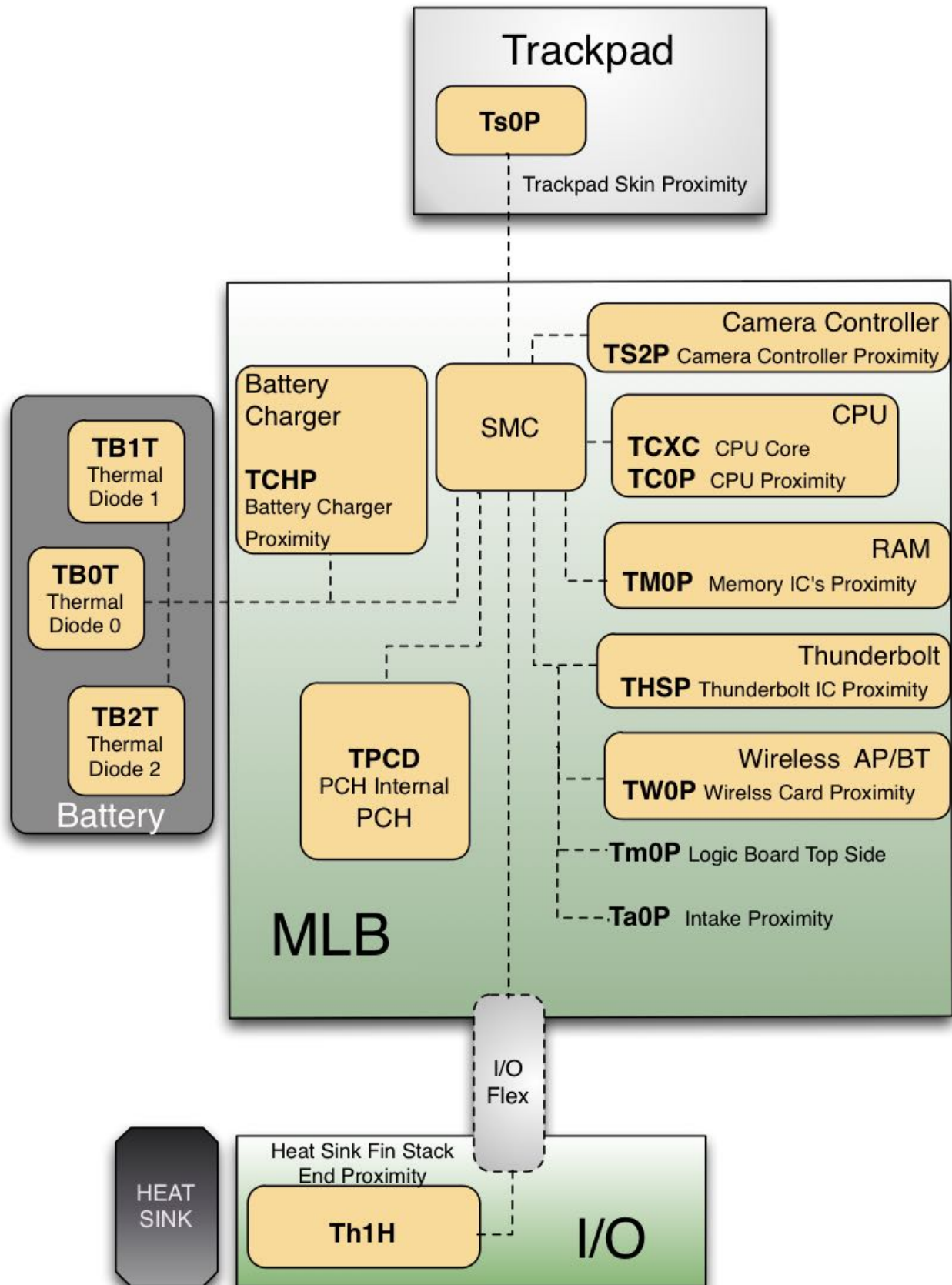
Thermal Sensor	Location	General Description	MR/ASD Name
Ta0P	Logic Board	Intake Proximity Temp	Intake Proximity Temp
TB0T	Battery	Internal Battery Sensor	Battery Thermal Diode 0
TB1T	Battery	Internal Battery Sensor	Battery Thermal Diode 1
TB2T	Battery	Internal Battery Sensor	Battery Thermal Diode 2
TC0P	Logic Board	Onboard CPU IC Proximity	CPU Proximity
TCHP	Logic Board	Battery Charger Proximity	Charger Proximity
TCXC	CPU Internal	CPU Core	CPU Core
Th1H	Left I/O board	Heat Sink Fin Stack End Proximity	Fin Stack
THSP	Logic Board	Thunderbolt IC Proximity	Thunderbolt Proximity
Tm0P	Logic Board	Logic Board Top Side	MLB Top Side
TM0P	Logic Board	Memory IC Proximity	Memory Proximity
TPCD	Logic Board	PCH Internal	PCH Die
Ts0P	Trackpad	Trackpad Skin Proximity	Trackpad Temp
TS2P	Logic Board	Camera Controller Proximity	S2 Camera Proximity
TW0P	Wireless Card or Logic Board	Wireless Card Proximity	AirPort Proximity

Electrical Sensors

Electrical Sensor	Location	General Description	MR/ASD Name
ALSL	Display	Ambient Light Sensor (Lux)	Light Sensor
MSLD	11-inch: Logic Board 13-inch: I/O Board	Clamshell Sleep Sensor (Closed/Open)	Magnetometer
CURRENT			
IC0R	Logic Board	CPU High (Core/AXG/DDR3/IO/SA) (Current)	Chipset 0 INA Highside
ID0R	Logic Board	DC In (Current)	DC in
IPB1	Logic Board	Battery Monitoring (Discrete)	Discrete Battery
IPBR	Logic Board	Battery Charger Monitoring (Current)	Charger BMON (Prod)
ISDC	Logic Board	SSD (Current)	SSD
VOLTAGE			
VAPC	Logic Board	Wireless Card (Voltage)	WLAN 3.3V
VC1C	Logic Board	CPU IO 1.05V (Voltage)	1.05 S0
VCS0	Logic Board	CPU Core (Voltage)	CPU Core
VD0R	Logic Board	DC In (Voltage)	DC in
VP0R	Logic Board	P-Bus (Voltage)	P-Bus
VSDC	Logic Board	SD Card (Voltage)	SD Card 3.3V (13-inch model only)
POWER			
PB1R	Logic Board	Battery Monitoring (Power)	Discrete BMON on Battery Power
PC0R	Logic Board	CPU Computing High Side (Power)	CPU Computing High Side
PDTR	Logic Board	AC/DC Output (Power)	AC/DC Output
PPBR	Logic Board	PBus on Battery (Power)	PBus on Battery Power
PSDC	Logic Board	SSD flash storage card (Power)	SSD Power

Thermal Sensor Map

The following map shows the general locations of thermal sensors and their associated parts within the computer housing.



Temperature Concerns

The normal operating temperature of this computer is well within national and international safety standards. Nevertheless, users may be concerned about generated heat. To prevent an unnecessary repair, compare a user's computer to a similar running model under similar load, if available at the repair site.

For more information, refer to articles

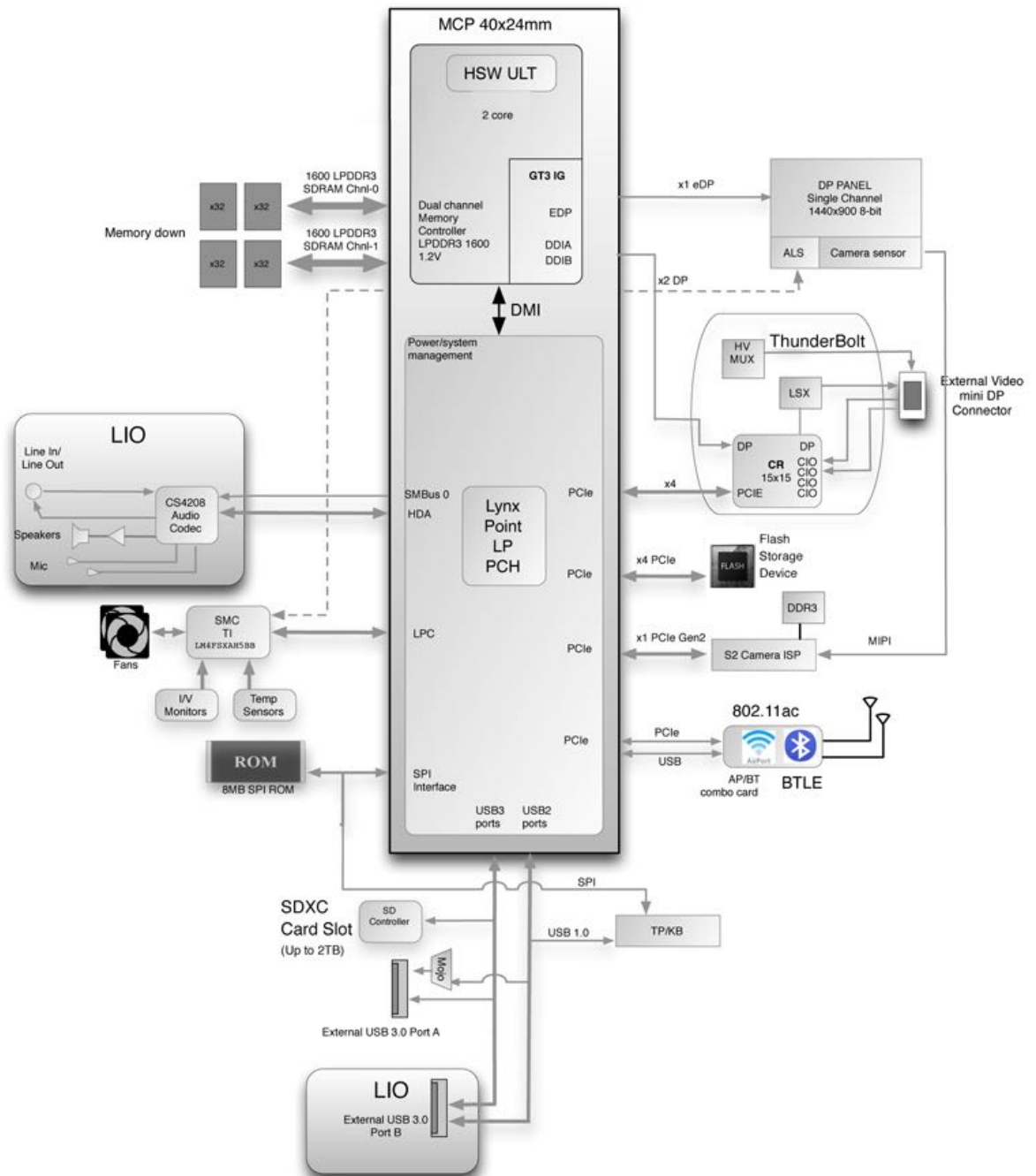
- [HT201640: Mac notebooks: Operating temperature](#)
- [HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity](#)
- [HT202179: About fans and fan noise in your Mac](#)

Block Diagram

Block Diagram for MacBook Air (13-inch, Mid 2013, Early 2014, Early 2015, 2017)

Refer to this diagram to see how modules are interrelated.

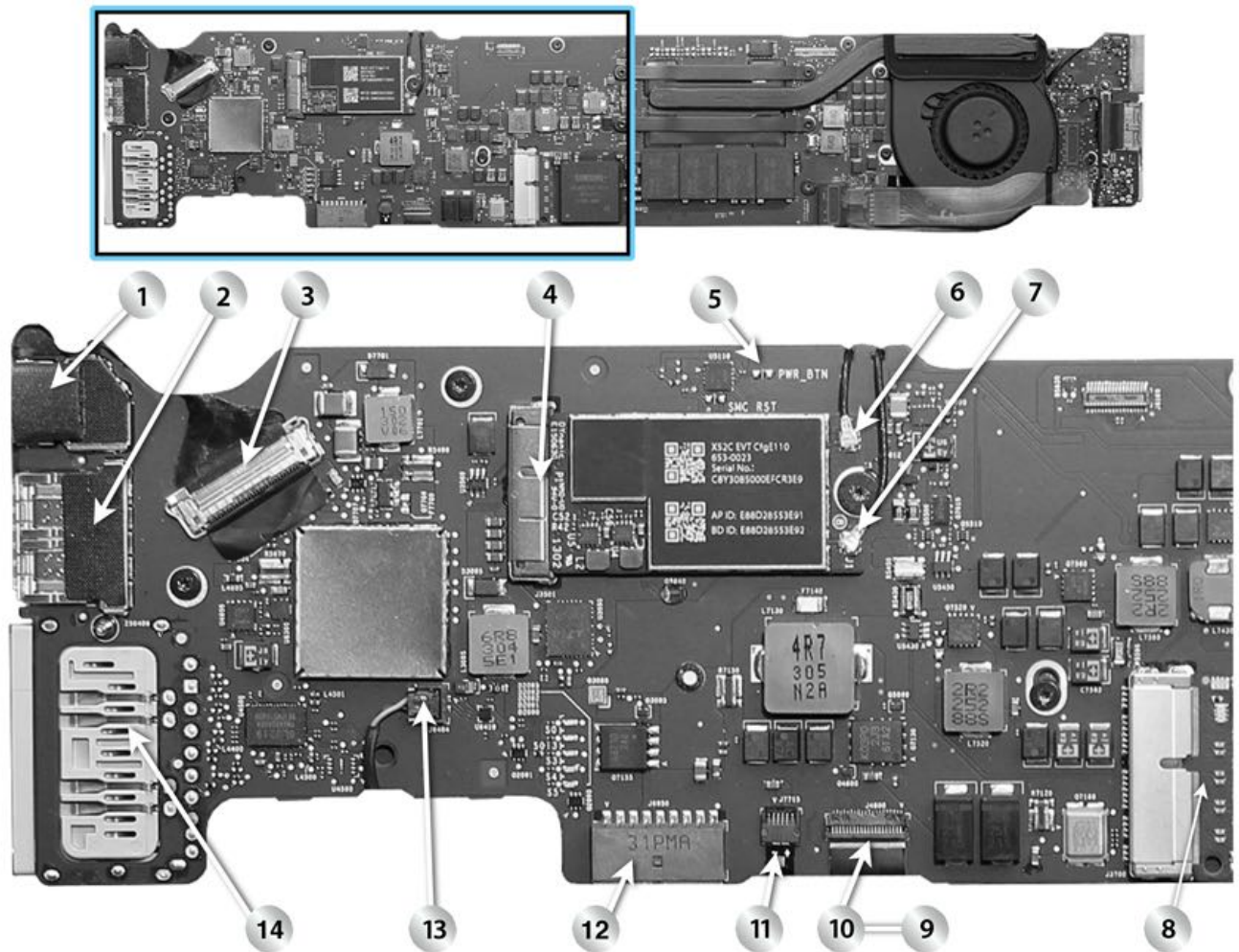
Note: The MacBook Air (13-inch, Early 2015 and 2017) models use the Broadwell CPU chipset.



Functional Overview

Functional Overview for MacBook Air (13-inch, Mid 2013, Early 2014, Early 2015, 2017)

Refer to these diagrams for symptoms related to connectors on the logic board and I/O board.



1 = Thunderbolt port

- No Thunderbolt I/O to Thunderbolt system devices
- No video output to Thunderbolt display
- No video output to external Mini DisplayPort display
- No video output to external display connected via DVI/VGA adapter

2 = Right USB port

- No power to USB device
- Not mounting connected USB device
- No USB 3.0 high speed I/O support

3 = LCD/LCD backlight

- No video on internal LCD
- Video but no display backlight

4 = Wireless card

- Wi-Fi/Bluetooth device(s) not seen in System Information
- Wi-Fi service cannot be enabled
- Bluetooth service cannot be enabled

5 = Power-on pads

- When shorted, these pads can switch on the computer (if keyboard cannot switch on the computer or is disconnected)

6 = Wi-Fi antenna connector

- No or poor Wi-Fi reception
- Loss of Wi-Fi connection

7 = Wi-Fi+Bluetooth antenna connector

- No or poor Wi-Fi reception
- Loss of Wi-Fi connection
- No pairing with Bluetooth devices
- Loss of Bluetooth connection

8 = Flash storage

- Flash storage device not visible in System Information
- OS boot failure from internal flash storage

9 = Keyboard flex cable (connected on trackpad board)

- No startup from keyboard
- Unresponsive keys

10 = Trackpad, trackpad button, thermal sensor, keyboard, power-on button

- No power on from keyboard
- Unresponsive keys
- No Multi-Touch or cursor movement
- No click action
- Trackpad thermal sensor input missing, fan running at full speed

11 = Keyboard backlight flex cable (part of top case)

- No keyboard backlight

12 = Battery

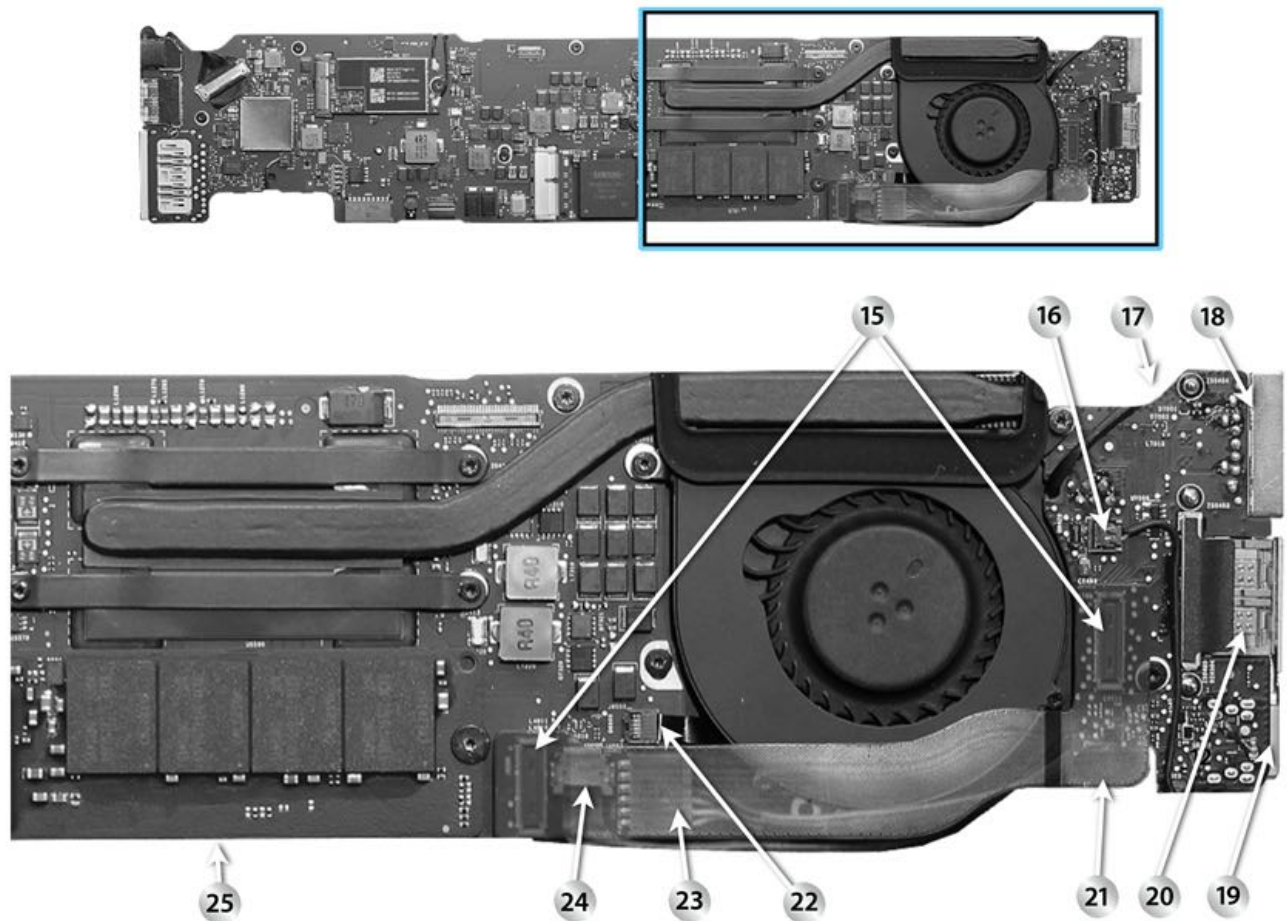
- Not running when on battery only
- Not charging (verify with correct model of power adapter)
- X symbol for battery in menu bar
- With battery removed, extended time before boot chime and fan running at full speed

13 = Right speaker

- No or distorted audio from right speaker

14 = SD card slot

- No SD card recognized
- SD card insert issues



15 = I/O flex cable

- No power
- MagSafe LED off
- No audio
- No left USB
- Heatsink thermal sensor missing, fan running at full speed
- Sleep sensor missing, will not sleep when clamshell is closed

16 = Left speaker

- No or distorted audio from left speaker

17 = Sleep sensor (on bottom side of I/O board)

- No sleep when display clamshell is closed
- No video to internal display, but video to external display if connected (sensor stuck)

18 = MagSafe connector

- No power
- No MagSafe LED
- No battery charge

19 = Headphone jack (part of I/O board)

- No audio to connected headphone
- No audio to internal speakers

20 = Left USB port (part of I/O board)

- No power to USB device
- Not mounting connected USB device
- No USB 3.0 high speed I/O support

21 = Microphone (under I/O flex cable)

- No internal audio input, with internal microphone selected in Sound Input Preferences

22 = Fan

- Fan not running
- Perception of noisy fan
- Intermittent shutdown

23 = I/O board power cable (under I/O flex cable)

- No power
- MagSafe LED off
- No audio, no left USB port

24 = FaceTime HD camera & ambient light sensor (part of display clamshell)

- No camera video, blurred or monochrome video
- No dimming of display in low light conditions
- Keyboard backlight cannot be enabled

25 = Onboard memory (soldered to logic board)

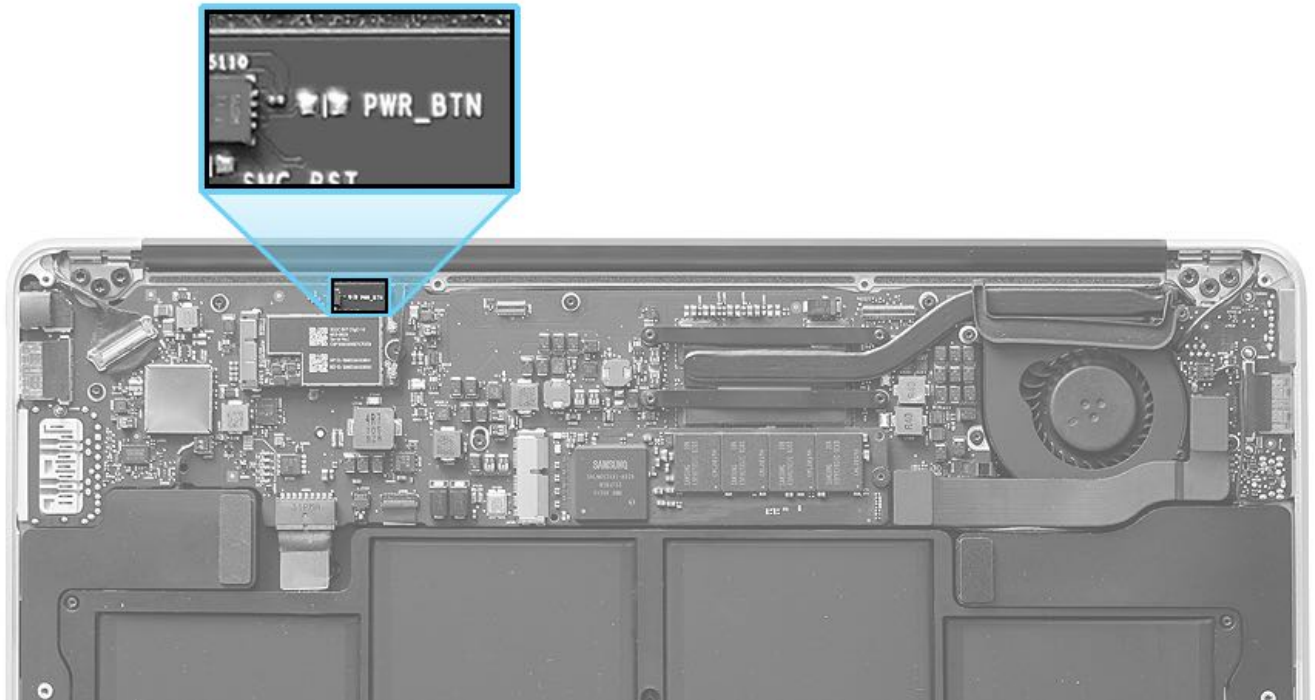
- 3 beep tones on startup
- Freeze or kernel panic
- Horizontal video lines

Logic Board Power-On Pads

Logic Board Power-On Pads for MacBook Air (13-inch, Mid 2013, Early 2014, Early 2015, 2017)

To start up the computer using the power-on pads, follow these steps:

1. To test startup on battery power, remove bottom case only and go to step 3.
2. To test startup using power adapter, remove bottom case and disconnect battery cable to force logic board to use power adapter only.
3. Visually locate power-on pads next to IPD flex cable connector.
4. Using a jeweler's flat-blade screwdriver, touch power-on pads to power on logic board.
Caution: Avoid touching anything other than power-on pads. Doing so could damage logic board.
5. Listen for startup sound and/or fan operation to confirm power turns on.



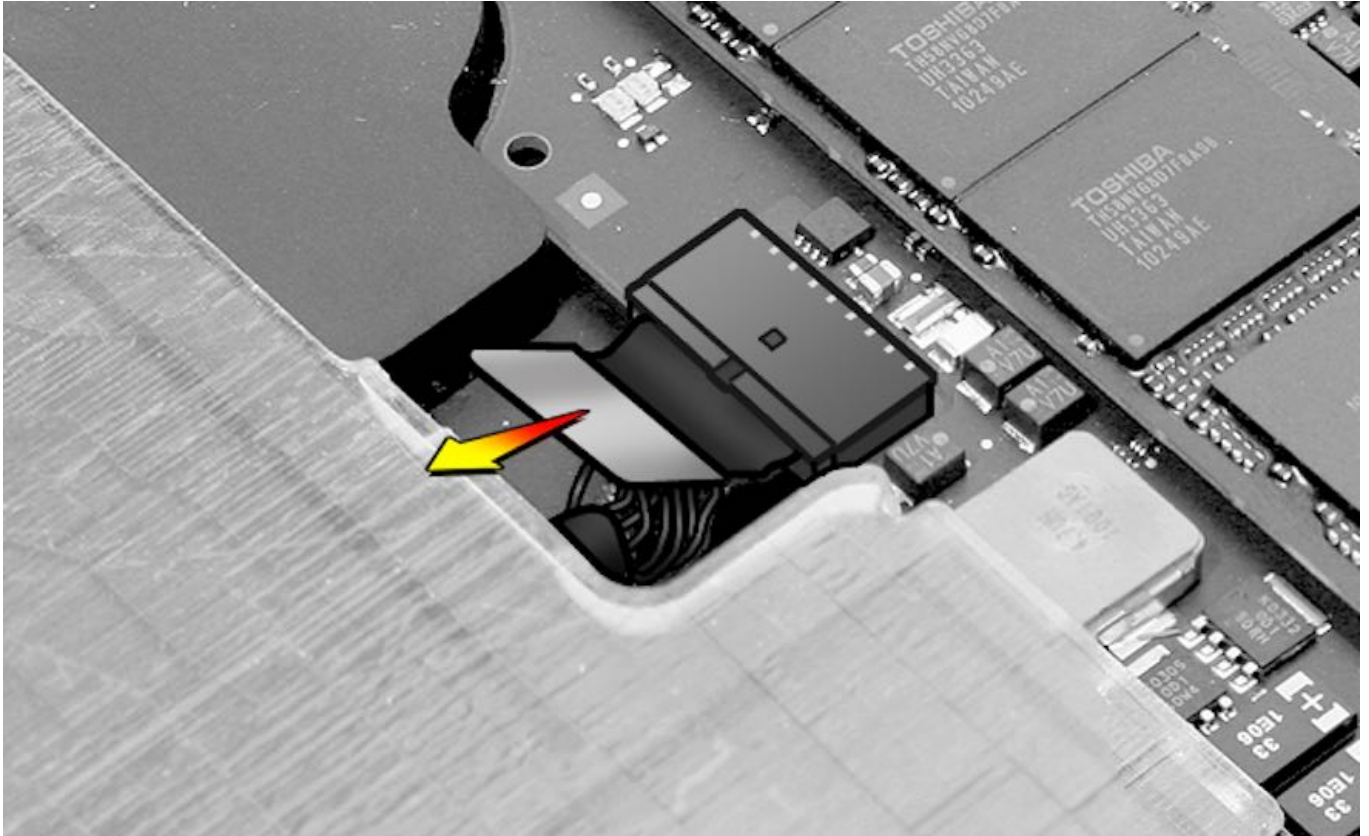
Connector Types on Logic Board

On the logic board are several types of connectors, each requiring special handling. Make sure you read these tips before disconnecting and installing the connectors.

Battery Connection

1. Pull tab on battery to disconnect.
2. Use fingers to slide cable into connector.

For video instruction, refer to article [SV79: Platform Connectors Video](#).



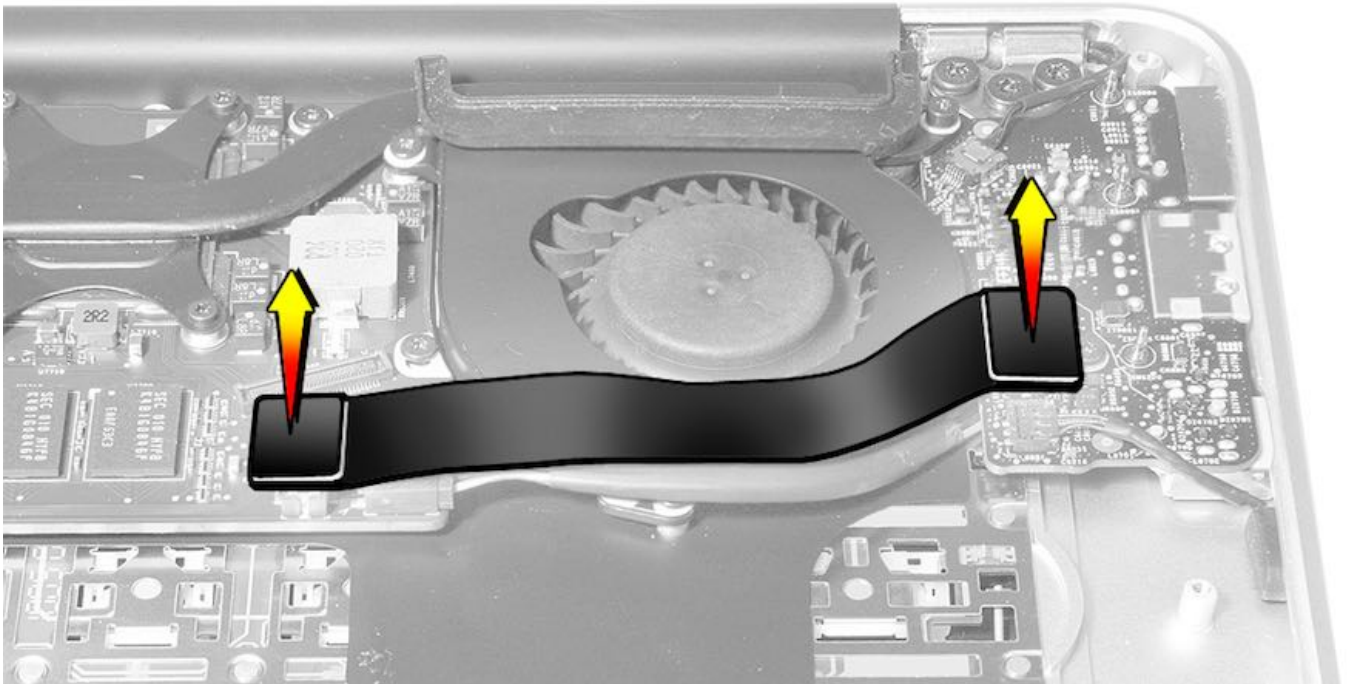
Low-Profile Solid Platform Flex

1. Remove and insert I/O flex cable connector vertically. The connectors are susceptible to bent pins if inserted improperly.
2. Keep connector level to board and press evenly to install cable.

Example:

- I/O flex cable

For video instruction, refer to article [SV89: Solid Platform Flex Connectors Video](#).



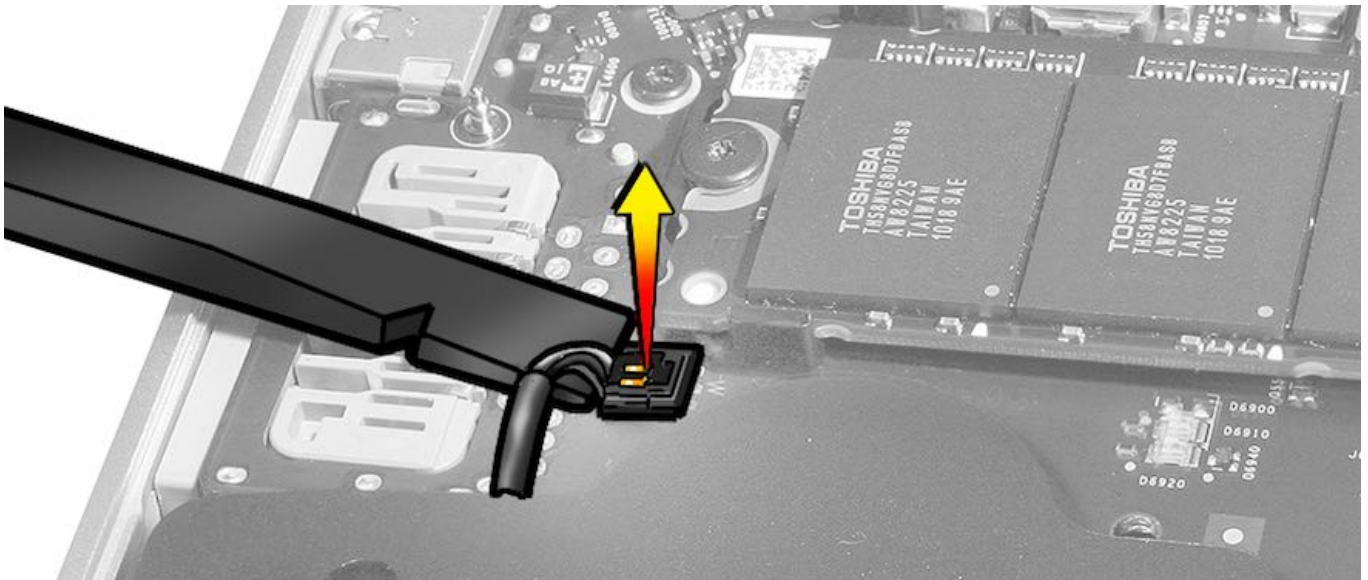
Vertical Insertion (JST)

1. Use black stick under cable to remove.
2. Keep connector level to board when disconnecting and reconnecting.
3. Press evenly when reconnecting or connector can be tipped up and not fully seated.

Examples:

- Right speaker
- Left speaker

For video instruction, refer to article [SV83: Japan Solderless Terminal \(JST\) Connectors Video](#).



Locking Lever

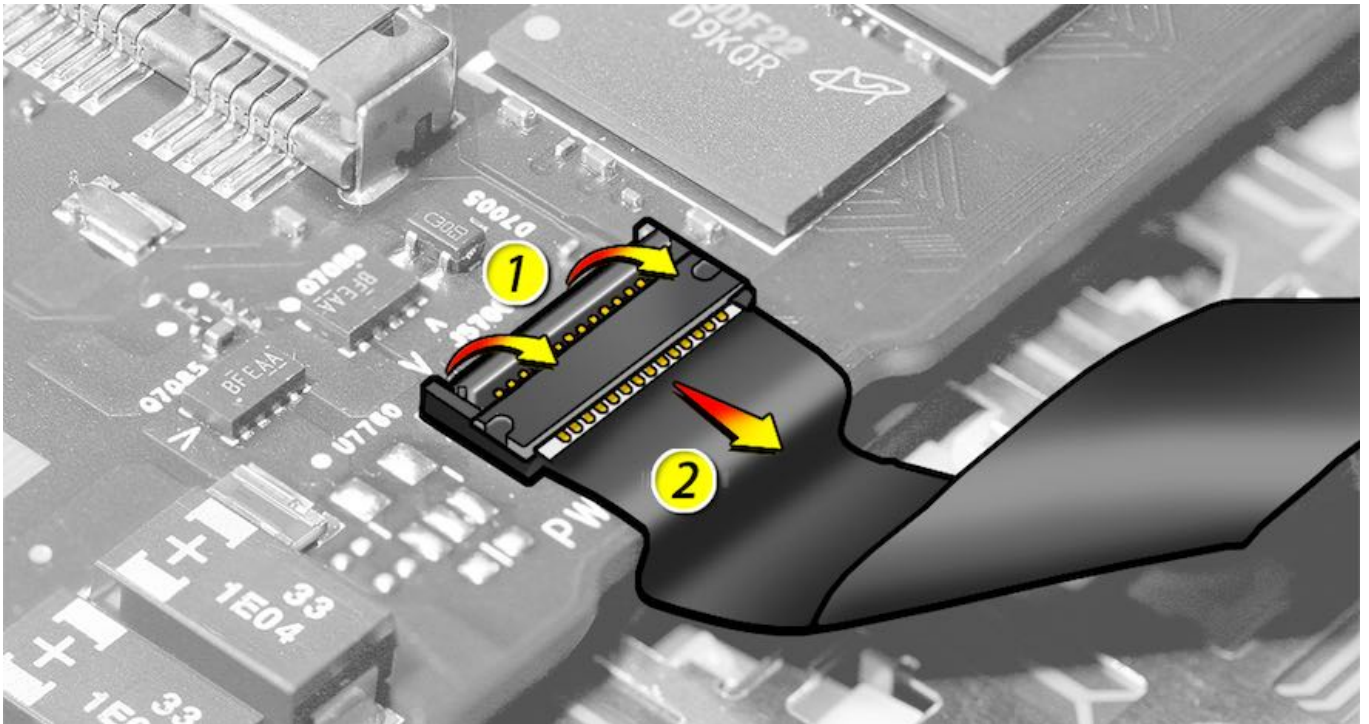
1. Flip up lever 90 degrees for cable removal.
2. Slide connector into receptacle on same horizontal plane as logic board.
3. Lock down lever after inserting cable.
4. Close lever when handling or shipping a logic board module, whether a known-good or a known-bad board.

Examples:

- Fan
- Keyboard input cable (IPD)
- Trackpad flex cable

Important: Push IPD flex cable all the way into connector to prevent “no power” symptoms.

For video instruction, refer to article [SV85: Locking Lever Connectors Video](#).



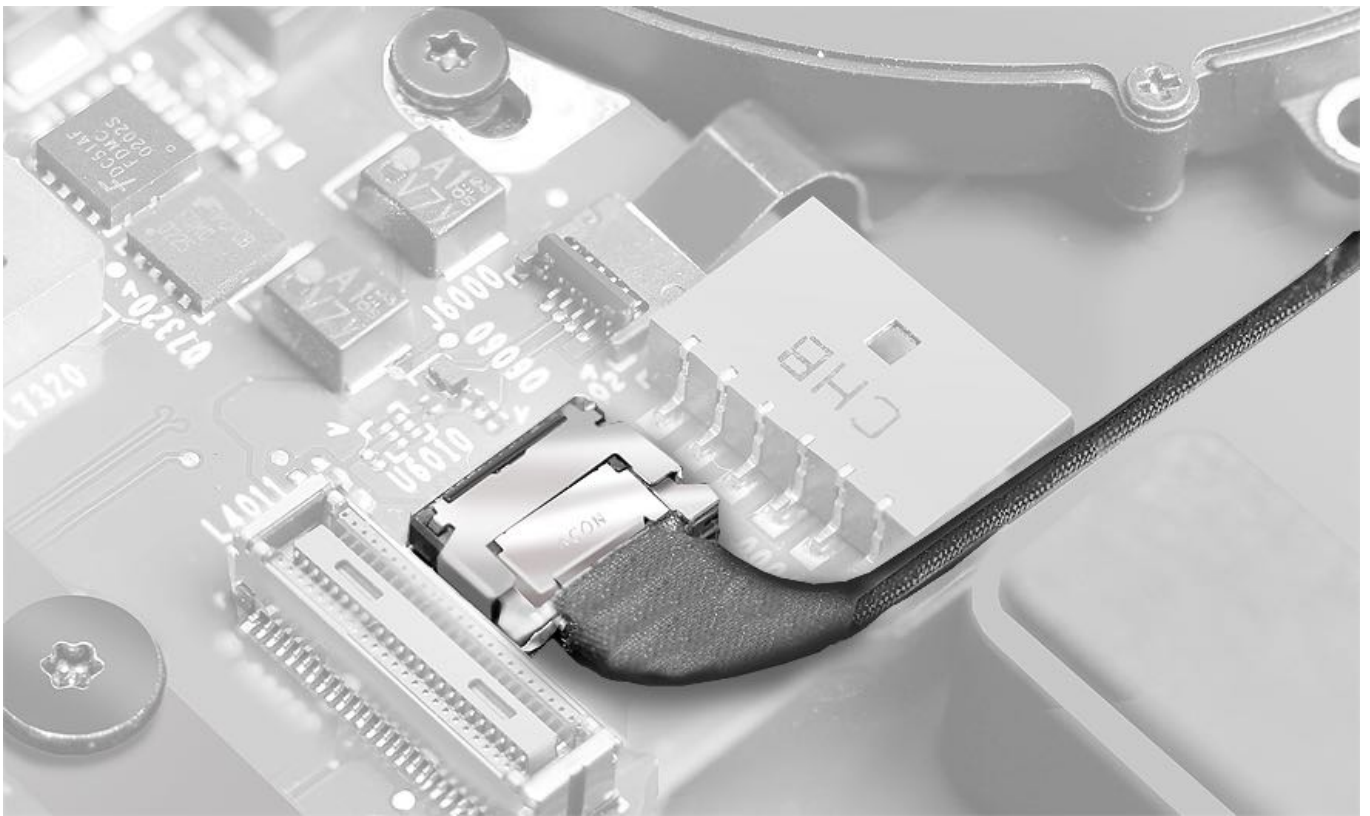
Thin, Multi-Pin Horizontal Insert

1. Use black stick on alternating sides to evenly disconnect cable.
2. Slide connector into receptacle on same horizontal plane as board.

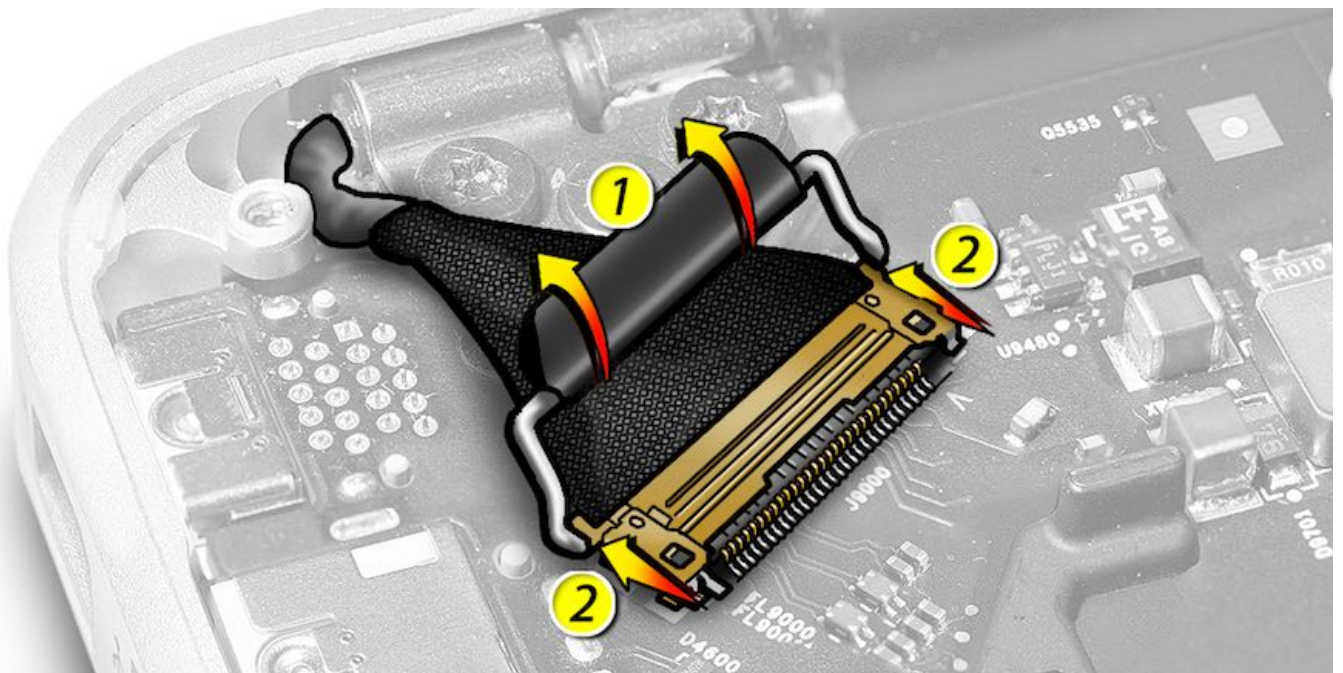
Examples:

- Camera cable
- Display cable (eDP)

For video instruction, refer to article [SV87: Multi-Pin Horizontal Insert Connectors Video](#).



Note: Flip over lock bar before disconnecting eDP cable, but do not use bar as a handle. When cable is fully installed, flip lock bar over leads to secure cable in place.



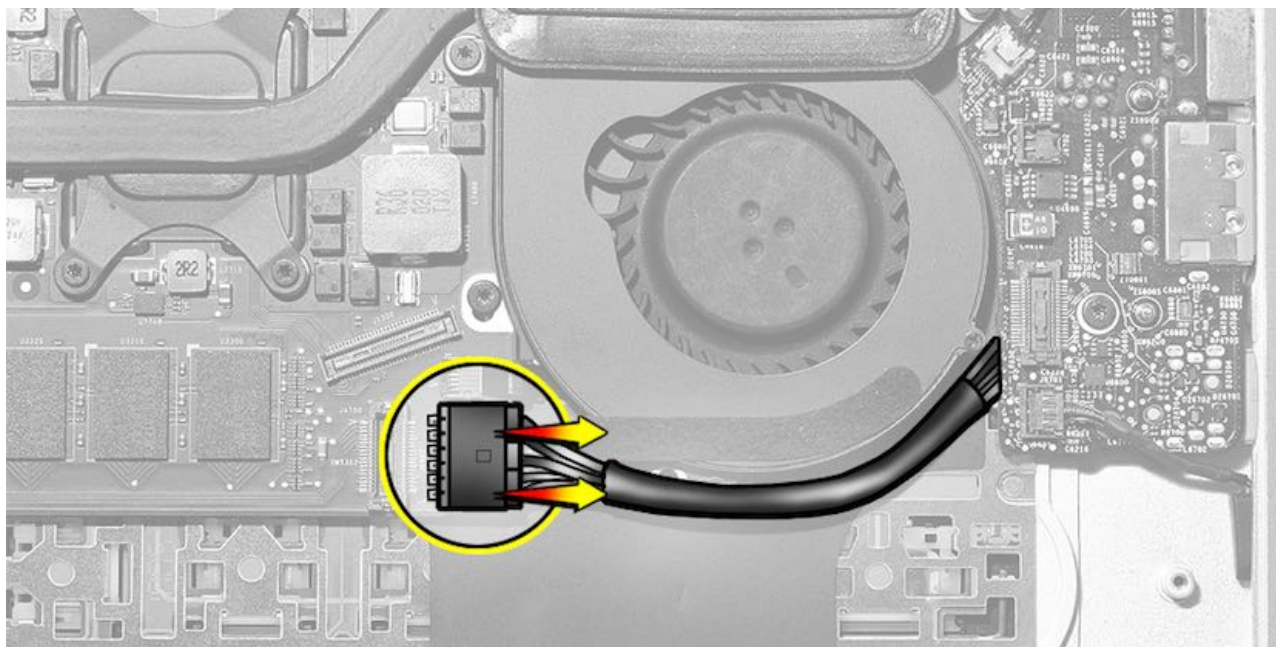
Horizontal Install

1. Pull connector, not cable, to remove.
2. Slide connector into receptacle on same horizontal plane as board.

Example shown:

- I/O power cable

For video instruction, refer to article [SV81: Horizontal-Install Connectors Video](#).



Tools

Tools for MacBook Air (13-inch, Late 2010, Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017)

Caution: To prevent scratches or other cosmetic damage to the computer housing, use a soft cloth as a protective layer when removing and installing the external screws.

The following tools are required to service this computer:

- Clean, soft, lint-free cloth
- ESD-safe workstation, including an ESD mat and wrist or heel strap
- ESD bags (for storing ESD-sensitive parts while removed from unit)
- Pentalobe screwdriver (923-0731)
- Protective battery cover (kit 076-1372, or cover only 922-9735)
- Phillips #000 screwdriver (magnetized)
- Torx T5 screwdriver (magnetized)
- Torx T8 screwdriver (magnetized)
- Black stick (nylon probe, 922-5065) or other nonconductive nylon or plastic flat-blade tool
- ESD-safe plastic or nylon tweezers for AirPort/Bluetooth cables
- Thermal grease syringe (922-7144)
- Alcohol wipes
- Kapton tape
- Pencil, to mark microphone alignment
- Magnifying glass, for reading serial number etched on bottom case
- Digital volt meter (troubleshooting)

Electrostatic Discharge (ESD) Precautions

Proper ESD precautions must always be used when servicing this product. Make sure you are working on a properly grounded ESD-safe mat and are wearing a properly connected ESD-safe wrist strap.

For more information about ESD, refer to:

- [OP100: Electrostatic Discharge Precautions and Myths](#)
- [ATLAS: ESD Precautions](#)

First Steps Overview

First Steps Overview for MacBook Air (13-inch, Mid 2013, Early 2014, Early 2015, 2017)

The following chart shows the parts that must be removed before a take-apart procedure can be performed. Procedures are listed in the left column; parts that must first be removed are indicated with one or more symbols in the row for each procedure.

- = remove part;
- = disconnect battery cable;
- ◆ = remove part only if replacing logic board with new logic board (transfer part to new board)

FIRST STEPS

PARTS

	Bottom Case	Battery	Right Speaker	Left Speaker	Flash Storage	Wireless Card	I/O Flex Cable	Fan	I/O Board	IPD Flex Cable	Heat Sink	Logic Board	Heat Sink Gasket	Trackpad	Display Clamshell	Display Clutch Cover	Top Case
Bottom Case	■																
Battery	■	■															
Right Speaker	■	■															
Left Speaker	■	■															
Flash Storage	■	□															
Wireless Card	■	□															
I/O Flex Cable	■	□															
Fan	■	□					■										
I/O Board	■	□					■	■									
IPD Flex Cable	■	■															
Heat Sink	■	□					■	■									
Logic Board *	■	■			◆	◆	■	■			◆						
Heat Sink Gasket	■	■					■	■				■					
Trackpad	■	■															
Display Clamshell	■	□					■	■									
Display Clutch Cover	■	□					■	■							■		
Top Case **	■	■	■	■			■	■	■	■		■	■	■	■		

Notes

* If logic board is being replaced by a new logic board, remove and transfer flash storage, wireless card, and heat sink.

** Top case comes with keyboard and microphone.

Take Apart Procedure Notes

Reassembly Steps

When no replacement steps are listed, replace parts in exact reverse order of Removal procedure.

Note About Images in This Guide

In some cases a pre-production model may have been used to document the procedures in this guide. Although there may be small differences in appearance between the image pictured and the computer you are servicing, the procedures are the same unless noted.

Screw Sizes

All screw sizes shown are approximate and represent the total length of the screw.



Bottom Case

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to article [SV159: Bottom Case Replacement Video](#).

Before you begin:

- Shut down computer.
- Unplug all cables.
- Put on ESD strap.
- Place computer face down on a clean, flat surface.



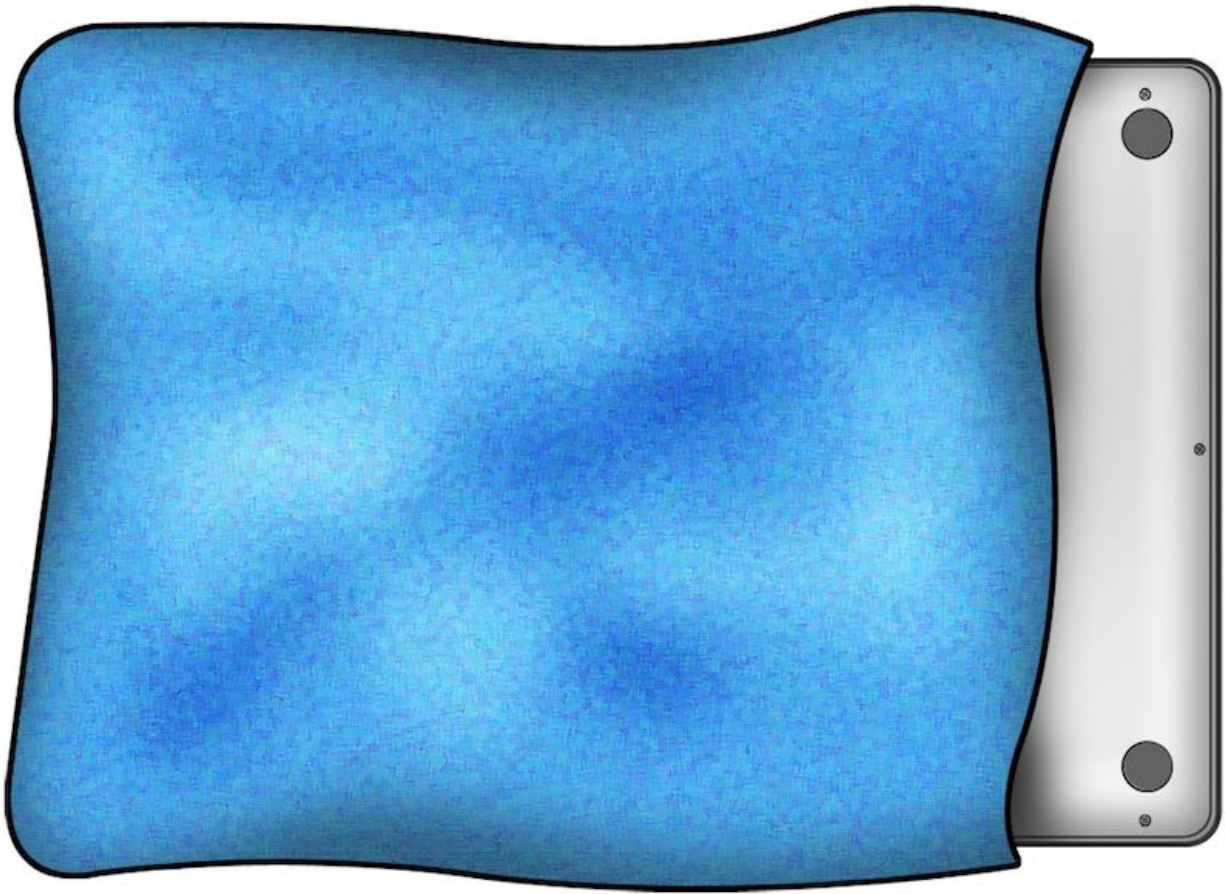
Tools

- ESD wrist strap
- Clean, soft, lint-free cloth
- Pentalobe screwdriver
- Black stick



Steps For Removal

Caution: To prevent scratches, use a protective cloth when working with metal tools.



1. Remove 10 Pentalobe security screws:

- Late 2010
 - 922-9659, 9 mm, long, two



- Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017
 - 922-9755, 9 mm, long, two

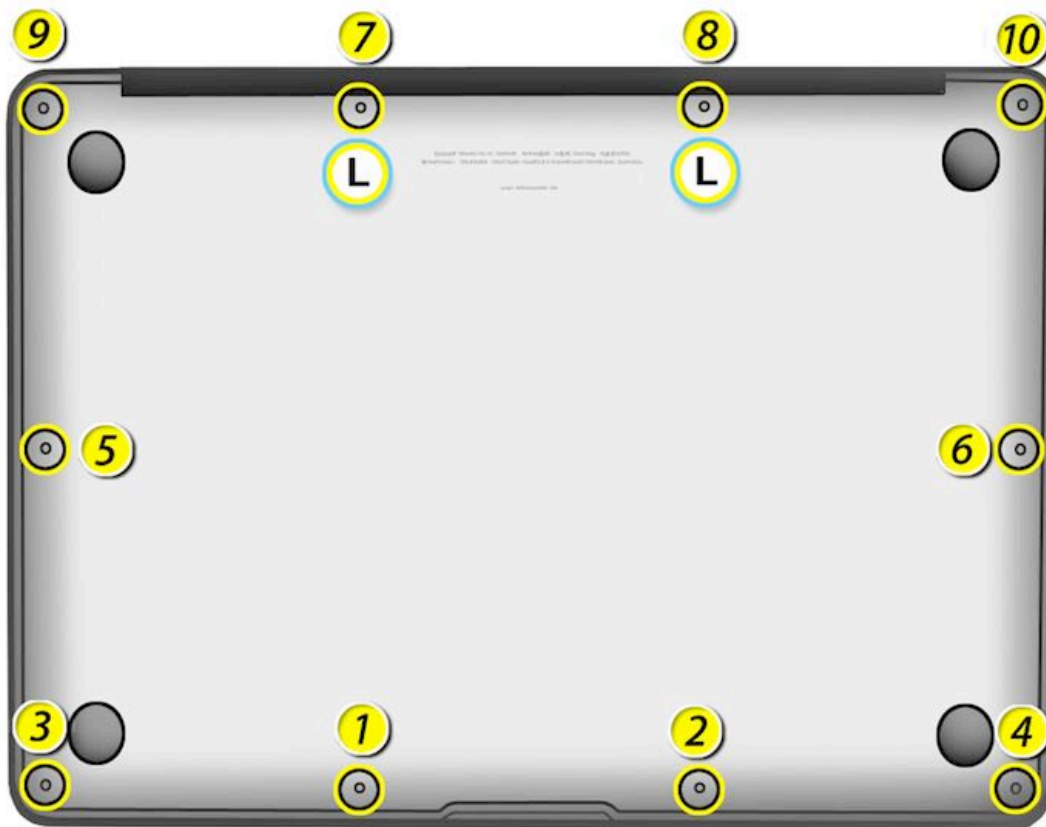


- Late 2010 and Mid 2011:
 - 922-9685, 2.48 mm, eight

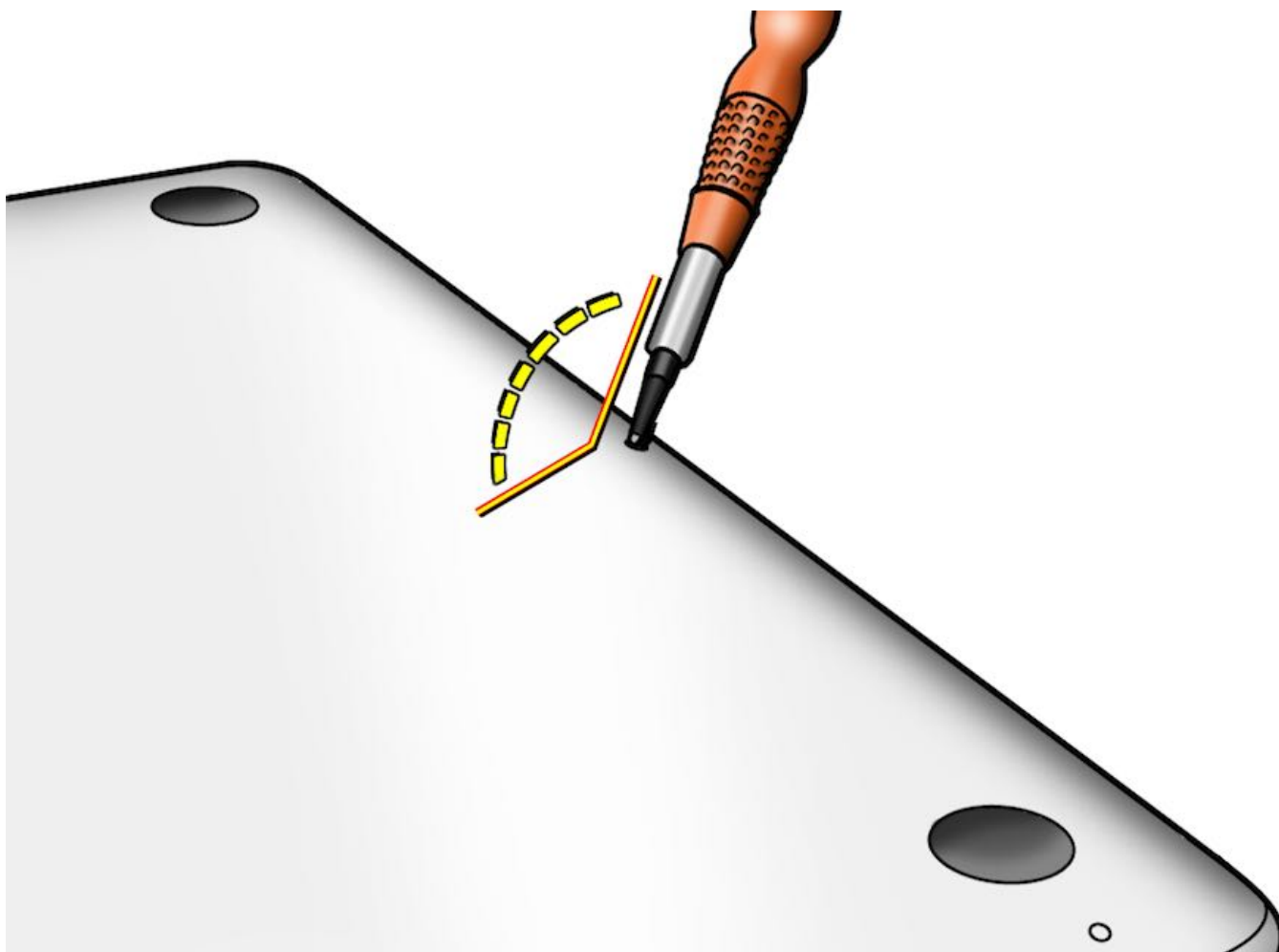


- Mid 2012, Mid 2013, Early 2014, Early 2015, 2017:
 - 923-0122, 2.48 mm, eight

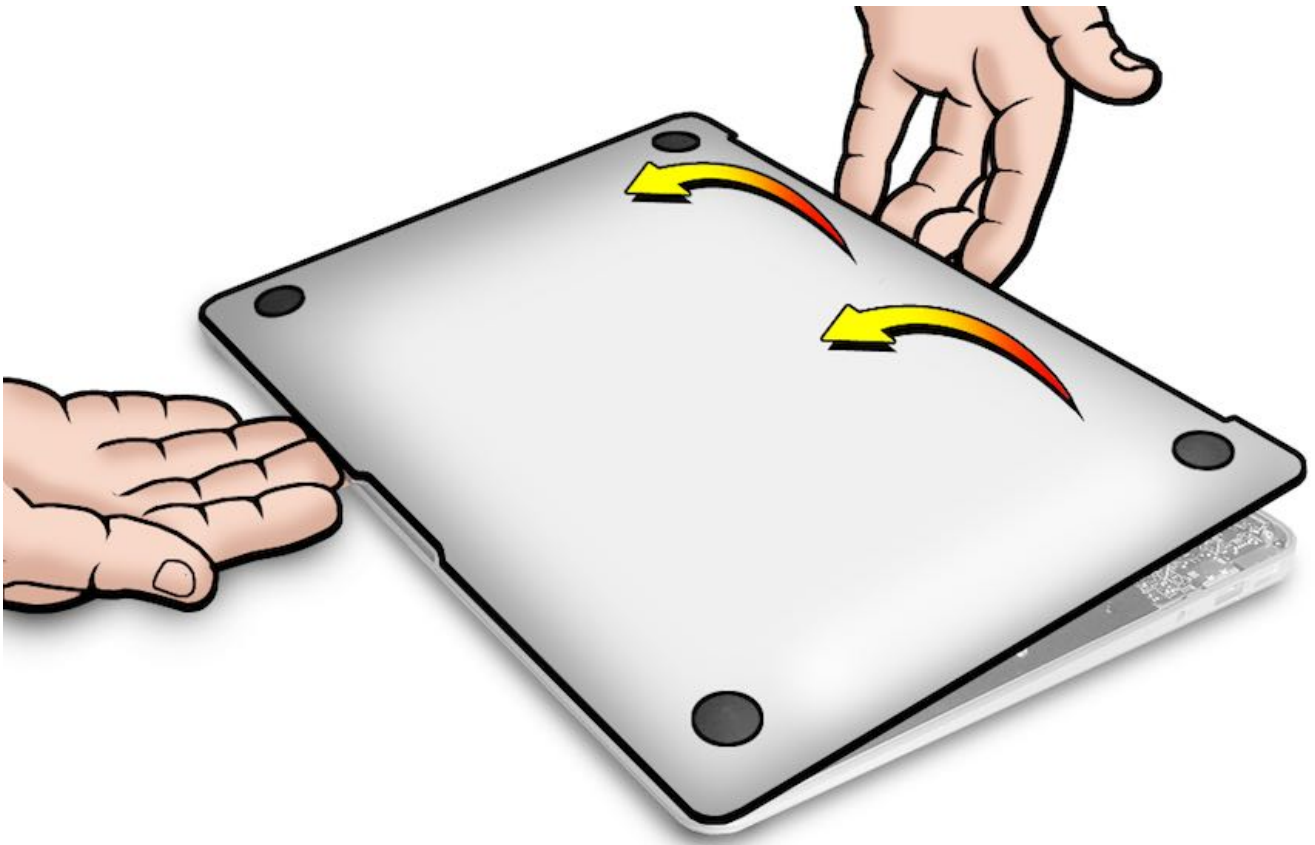




Important: All screws must be removed and installed at an angle.

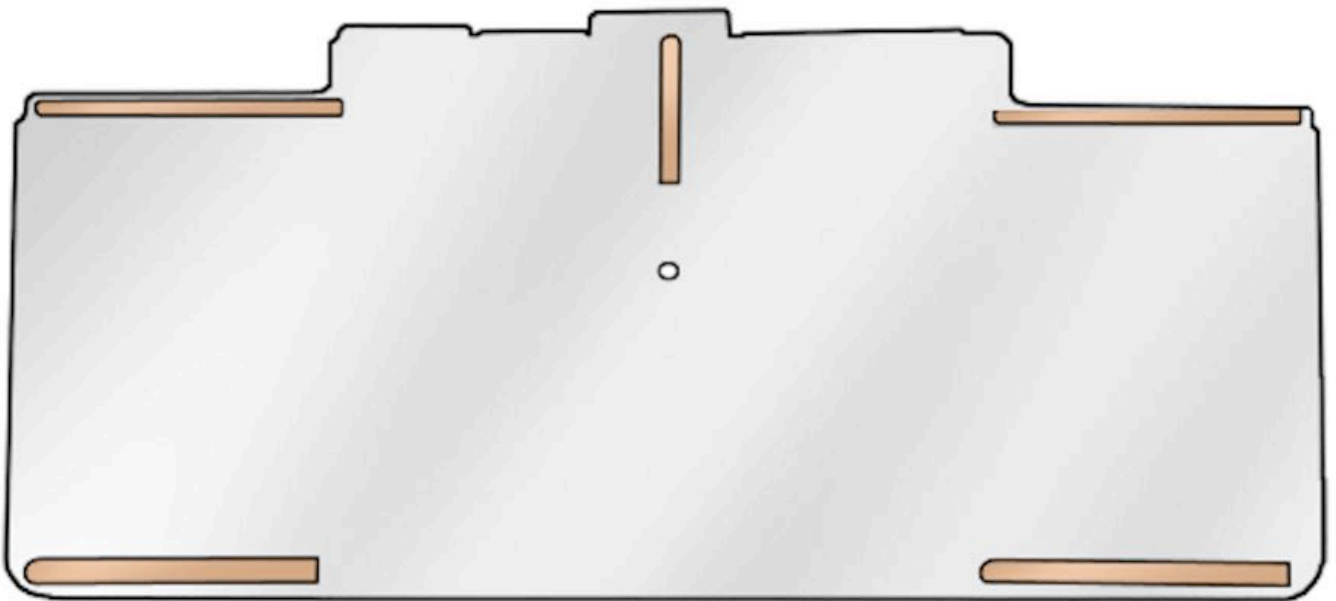


2. Lift from top edge and remove bottom case.



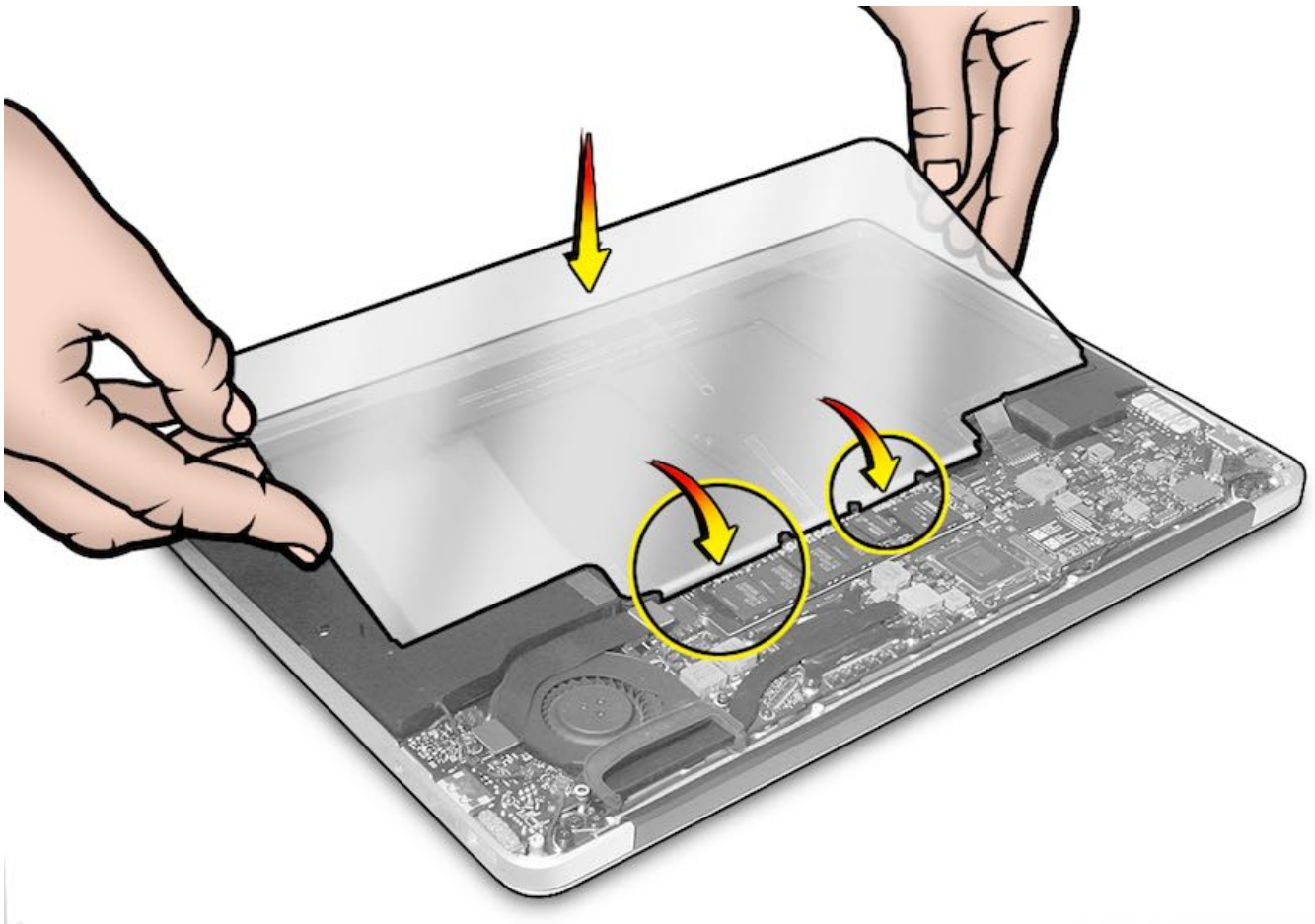
Important: Immediately after removing bottom case, always attach battery cover (922-9735) and disconnect battery cable from logic board. Refer to article [TP382: Battery Safety Precautions](#).

3. Remove adhesive strips from clean battery cover.



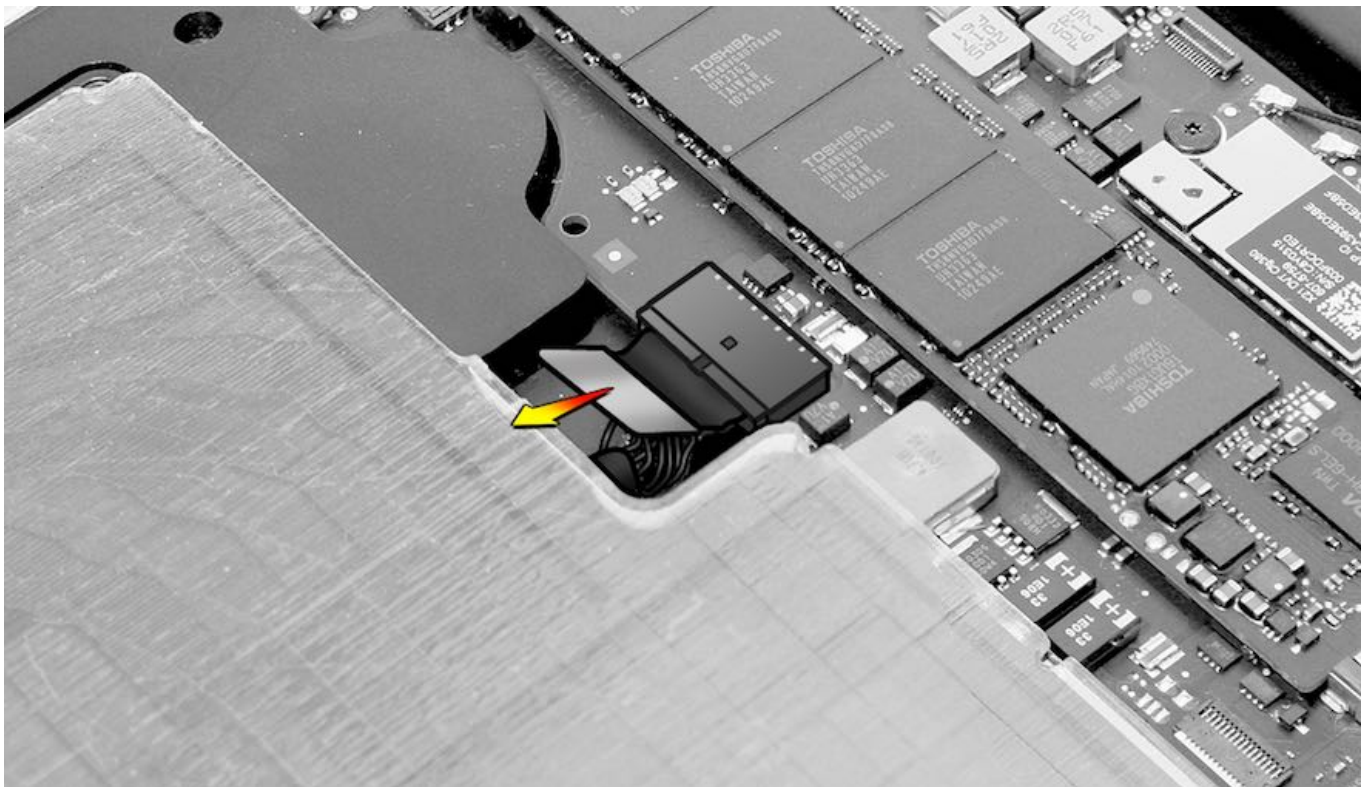
4. Using hooks at top of battery cover, tilt cover onto battery.

5. Gently secure cover by running your finger over adhesive locations.



6. Pull battery connector tab toward battery to disconnect it from logic board.

Important: Disconnect battery whenever performing repairs. There is no need to remove battery unless it blocks module being repaired.



Steps For Reassembly

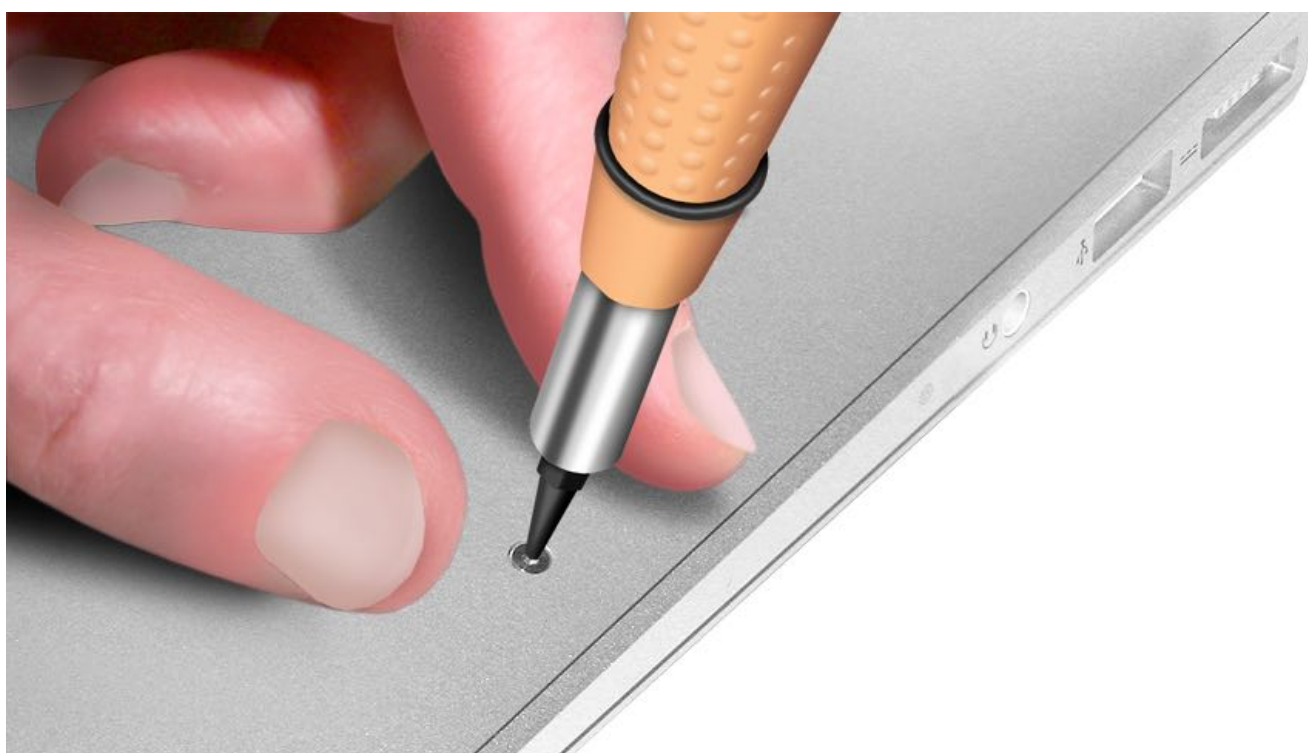
Note: If you are installing a replacement bottom case, use a fine-tipped permanent marker to write the original system serial number inside the bottom case.

1. Make sure bottom case interior is clean and free of debris.

2. Reconnect battery cable to logic board.
3. Remove battery cover from battery.
4. Install bottom case from front. Press lightly to ensure internal clip “snaps” onto battery.
5. Confirm all screw holes are aligned before installing screws.



Note: To prevent offsetting bottom case, press with two fingers around each screw hole before and during screw installation.



6. Install 10 Pentalobe security screws in order indicated.

Note: If sequence is not followed, bottom case might wobble when placed on level surface.

- Late 2010
 - 922-9659, 9 mm, long, two



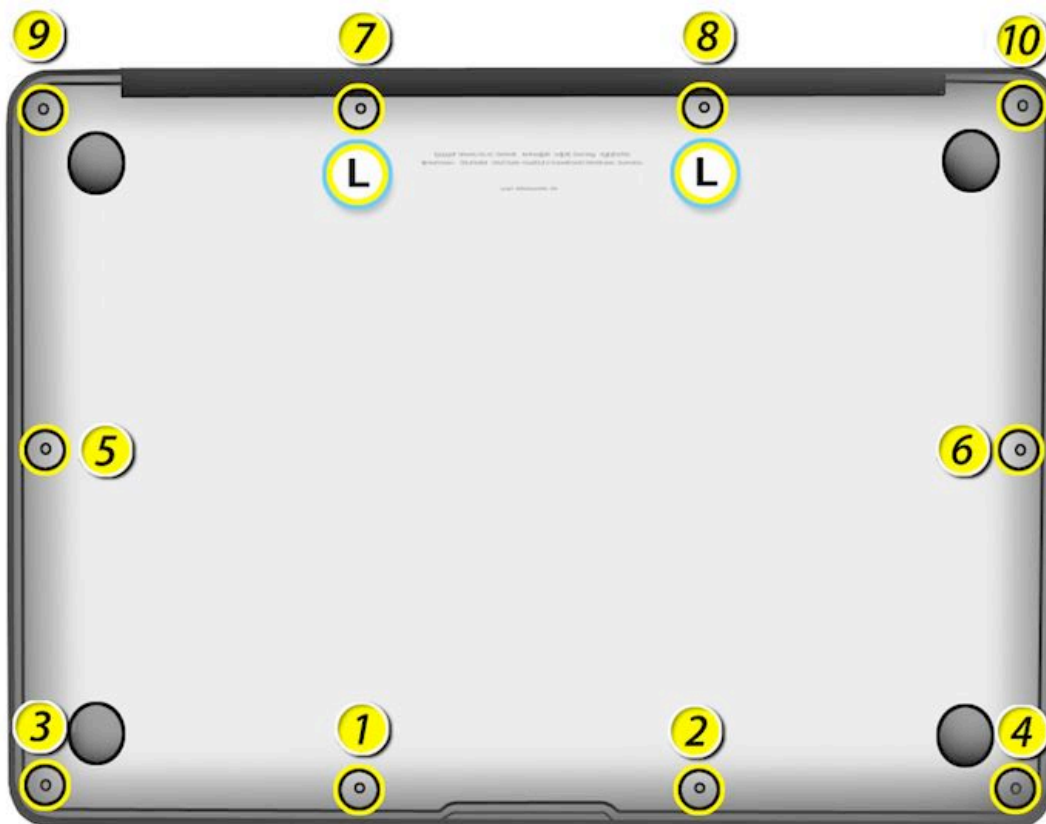
- Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017
 - 922-9755, 9 mm, long, two



- Late 2010 and Mid 2011:
 - 922-9685, 2.48 mm, eight



- Mid 2012, Mid 2013, Early 2014, Early 2015, 2017:
 - 923-0122, 2.48 mm, eight



Battery

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to article [SV160: Battery Replacement Video](#) (Mid 2012 to 2017).

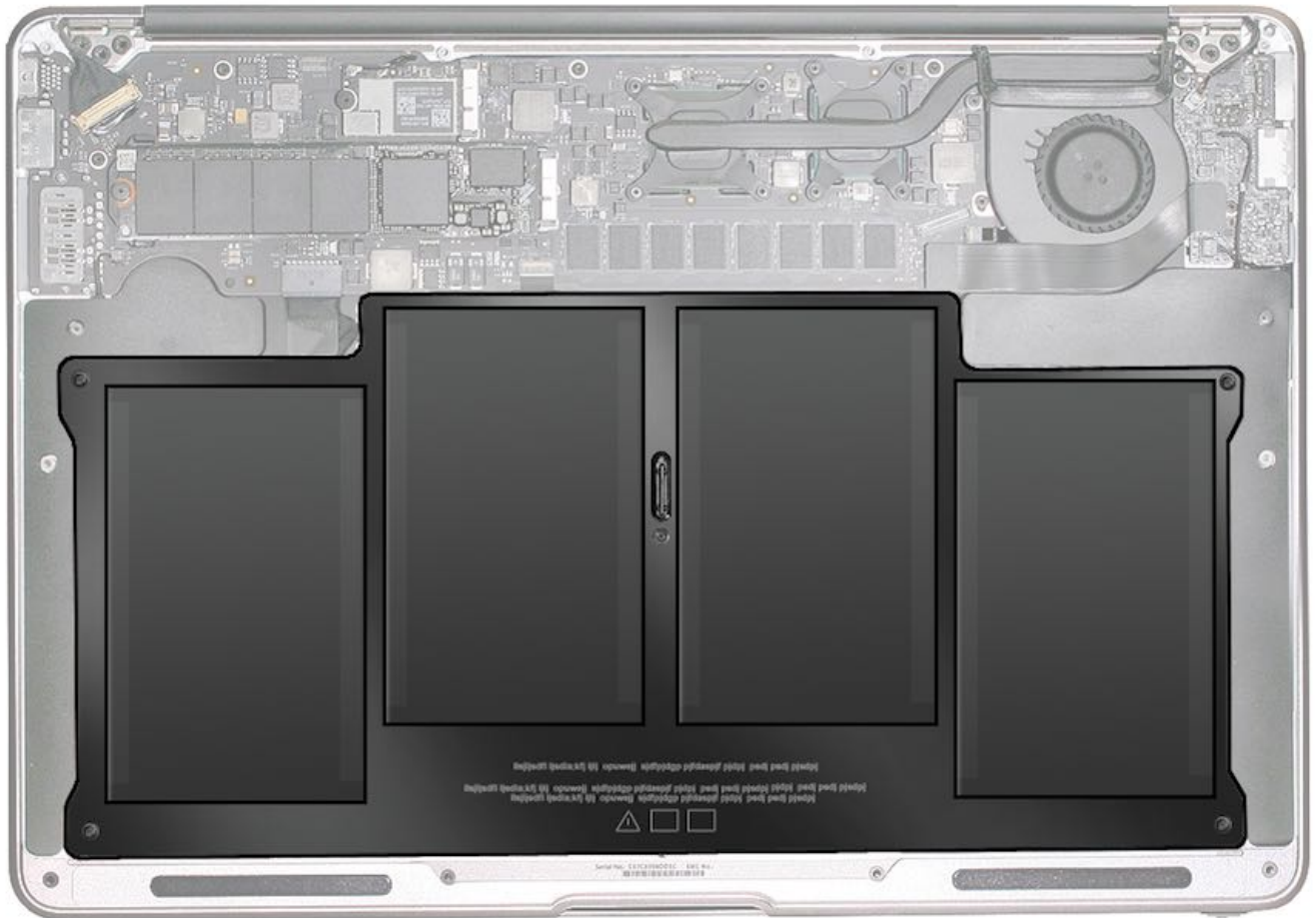
Remove:

- [Bottom Case](#)



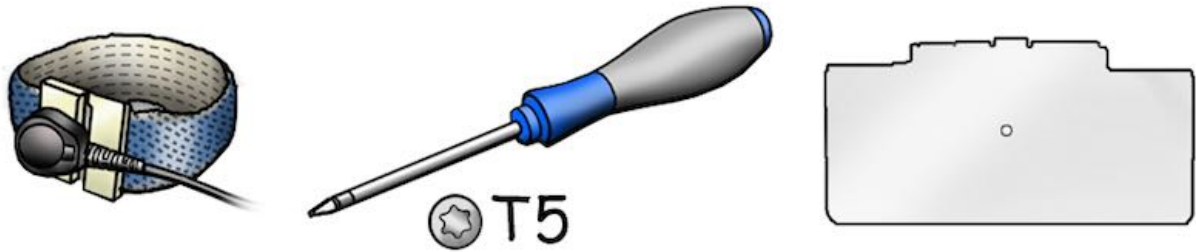
Important: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board.

Caution: Read [Battery Safety Precautions](#) before performing this procedure.



Tools

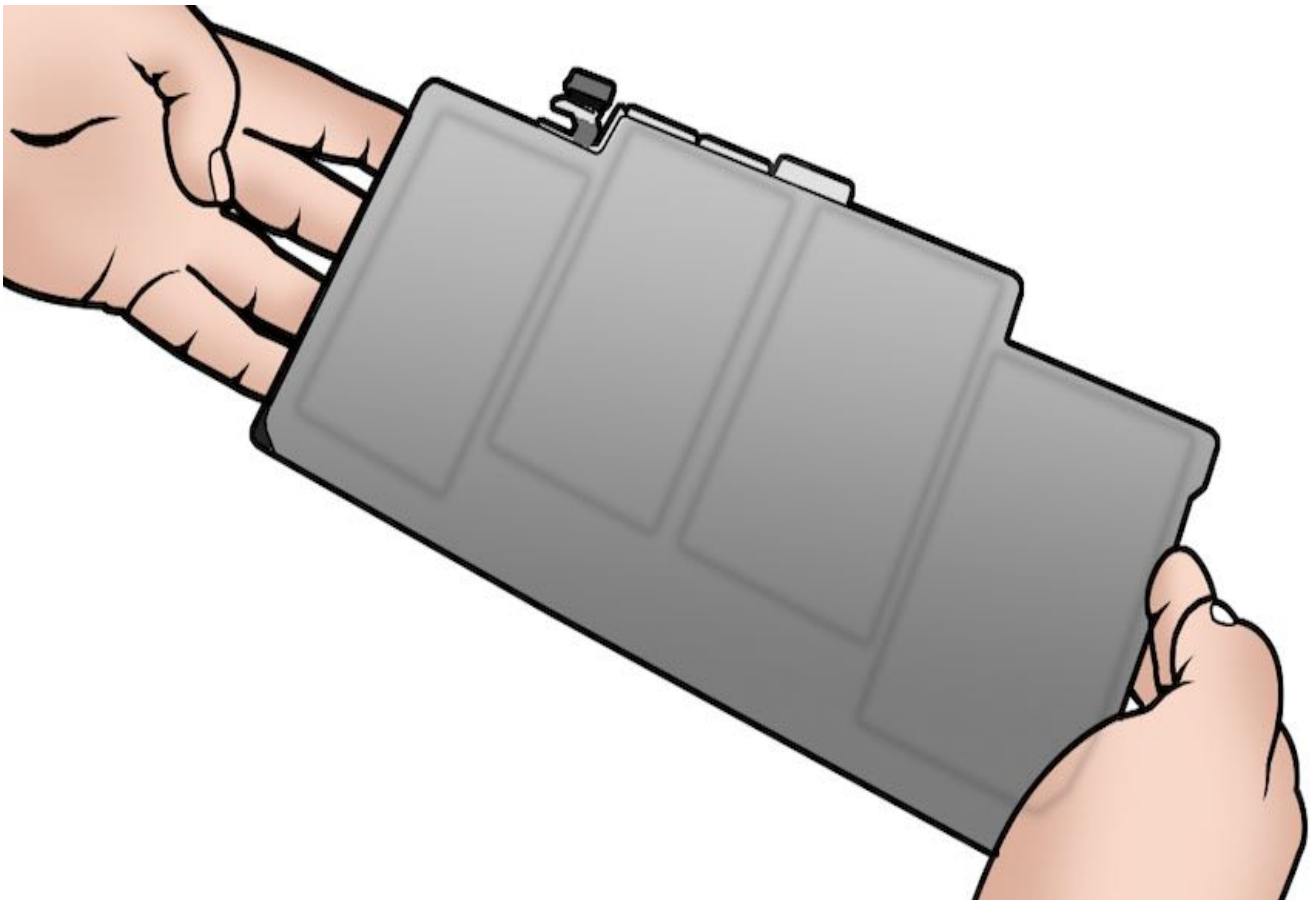
- ESD wrist strap
- Torx T5 screwdriver (magnetized)
- Protective battery cover, 922-9735 or 076-1372 (kit)



Steps For Removal

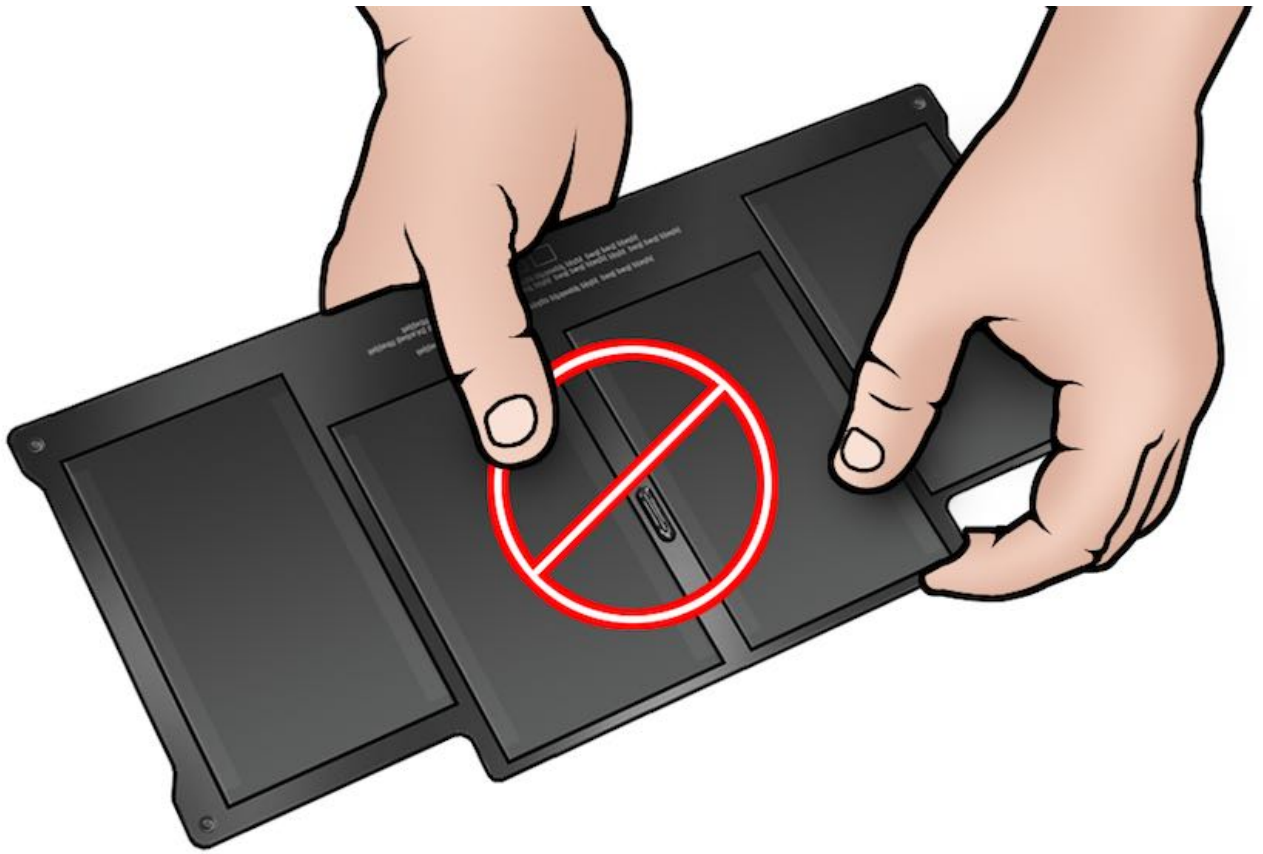


Warning: The battery contains several exposed, soft battery packs. Always attach the battery cover immediately after removing the bottom case.



Important:

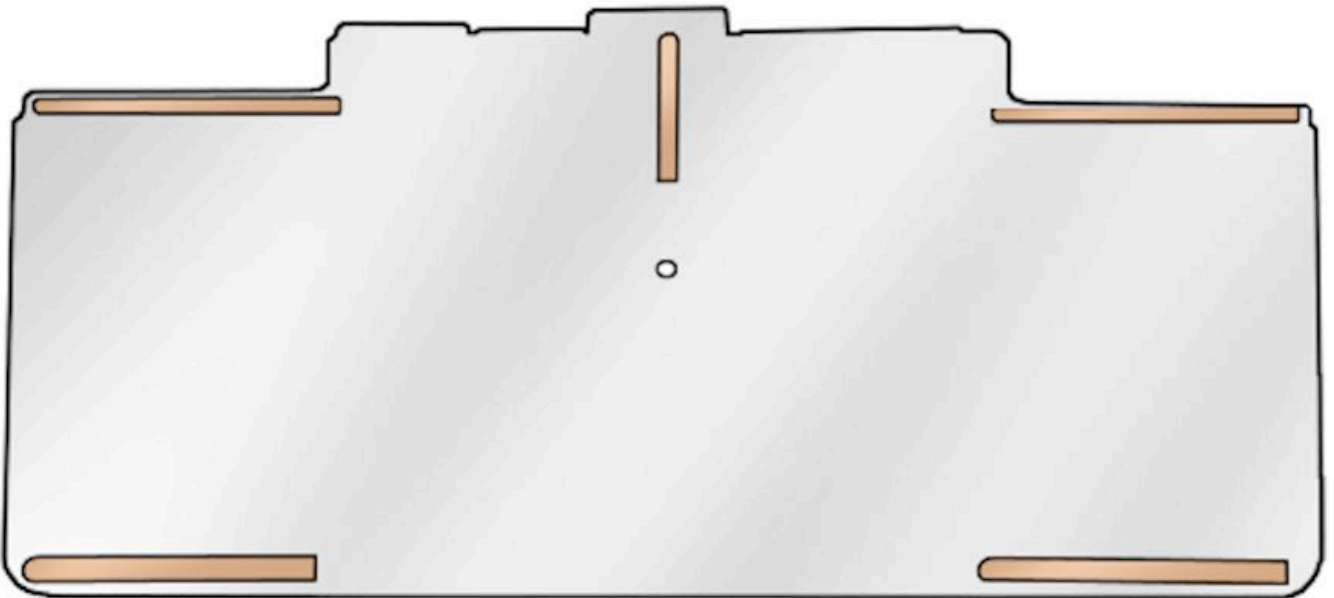
- Keep battery cover on battery at all times when battery is out of the computer.
- Handle battery with utmost care.
- Hold battery by edges only, with two hands at all times.
- Do not drop, stack, puncture, press, squeeze, crush, flex, twist or torque, or apply unnecessary pressure to a battery, as this may result in damage.
- If setting battery aside, make sure surface is clean — free of dust, dirt, screws, or other debris.
- If battery is dropped, replace it even if no damage is visible.



1. Remove adhesive strips from clean battery cover.

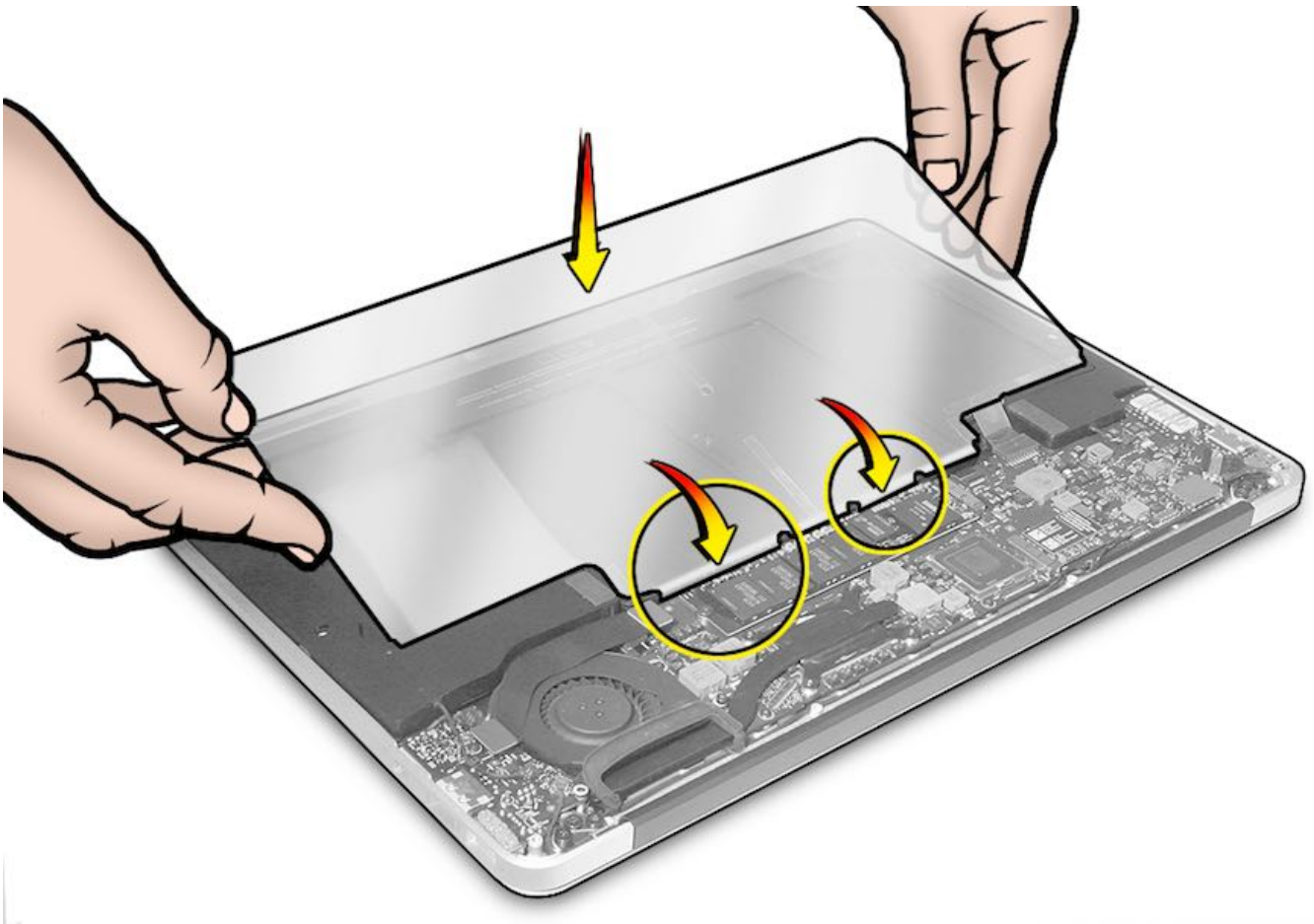


Warning: Do not perform this procedure without a clean battery cover.



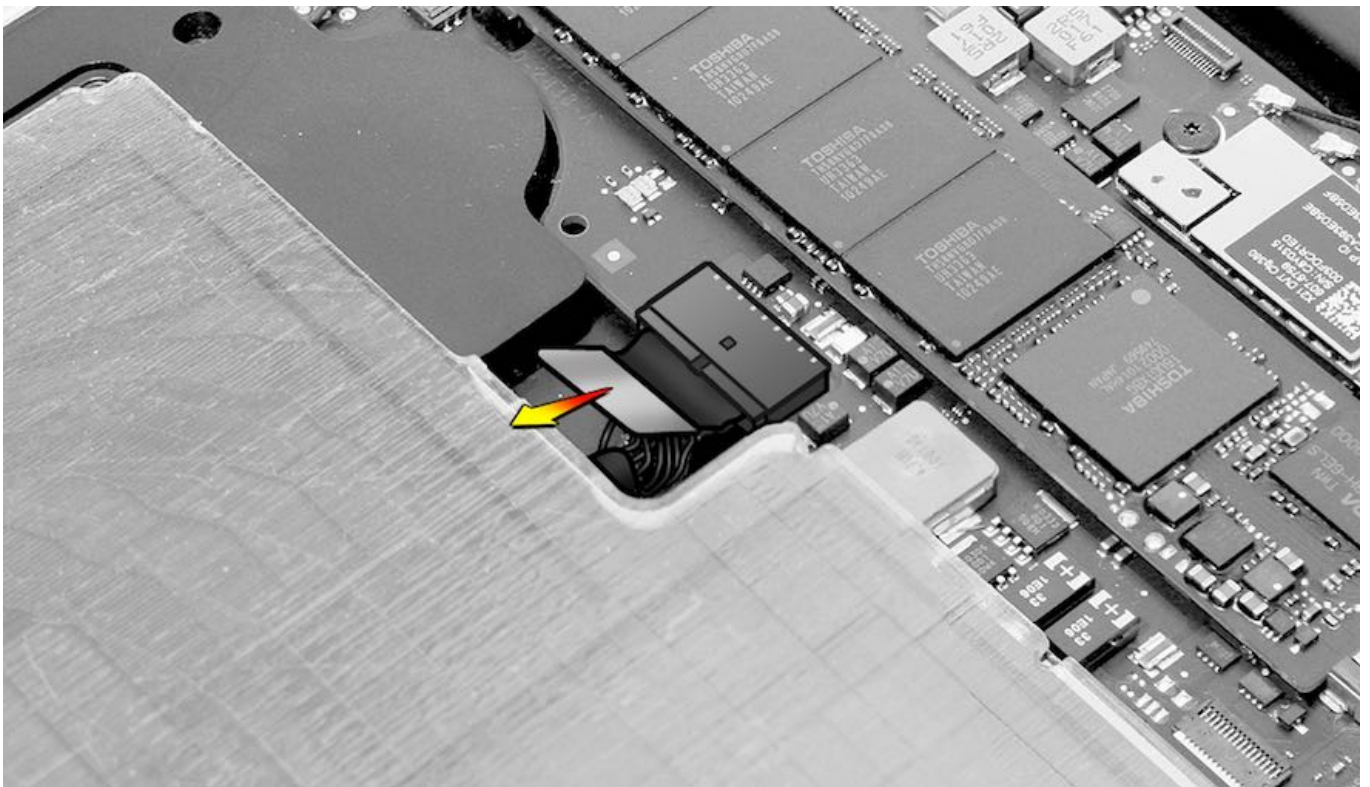
2. Using the hooks at the top of the battery cover, tilt the cover onto the battery.

3. Gently secure cover by running your finger over the parts of the cover that have adhesive.



4. Pull battery connector tab toward battery to disconnect it from logic board.

Important: Disconnect battery whenever performing repairs. There is no need to remove battery unless it blocks module being repaired.



5. Keeping screwdriver perpendicular to avoid battery damage, remove five Torx T5 screws; three long (L) and two short (S).

- Late 2010, three
- Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017, one at center
 - 922-9654, 6.3 mm



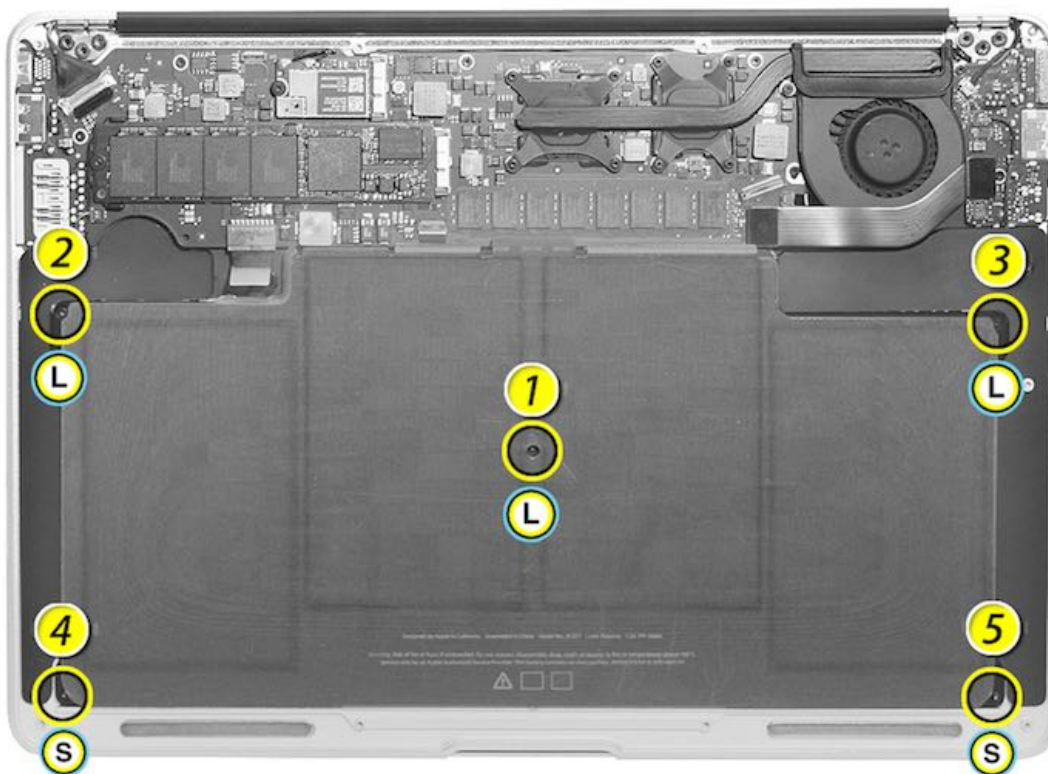
- Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017
 - 922-9969, 6.3 mm, two at sides



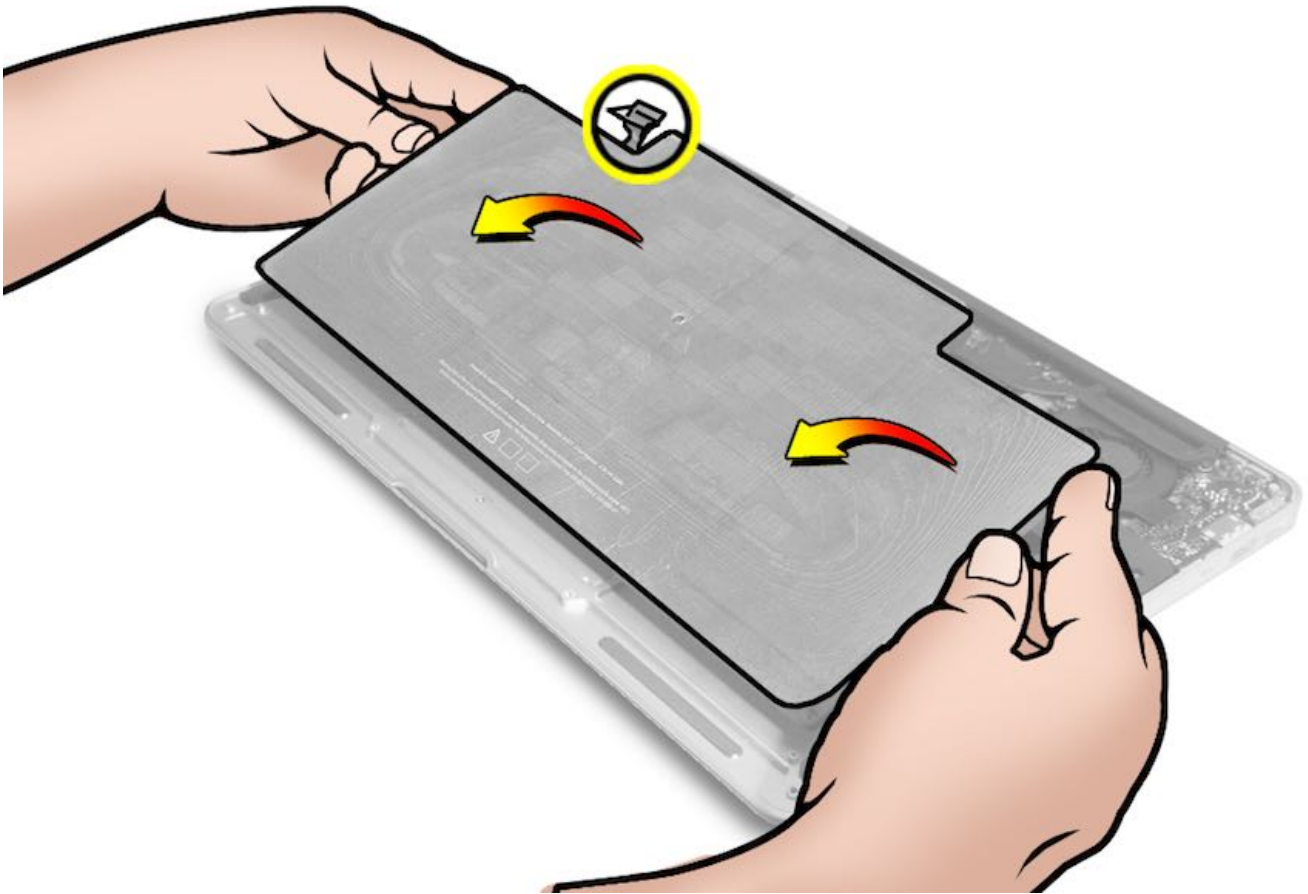
- Late 2010, Mid 2013, Early 2014, Early 2015, 2017
 - 922-9655, 2.4 mm, two at sides



- Mid 2011 and Mid 2012
 - 922-9657, 2.4 mm, two

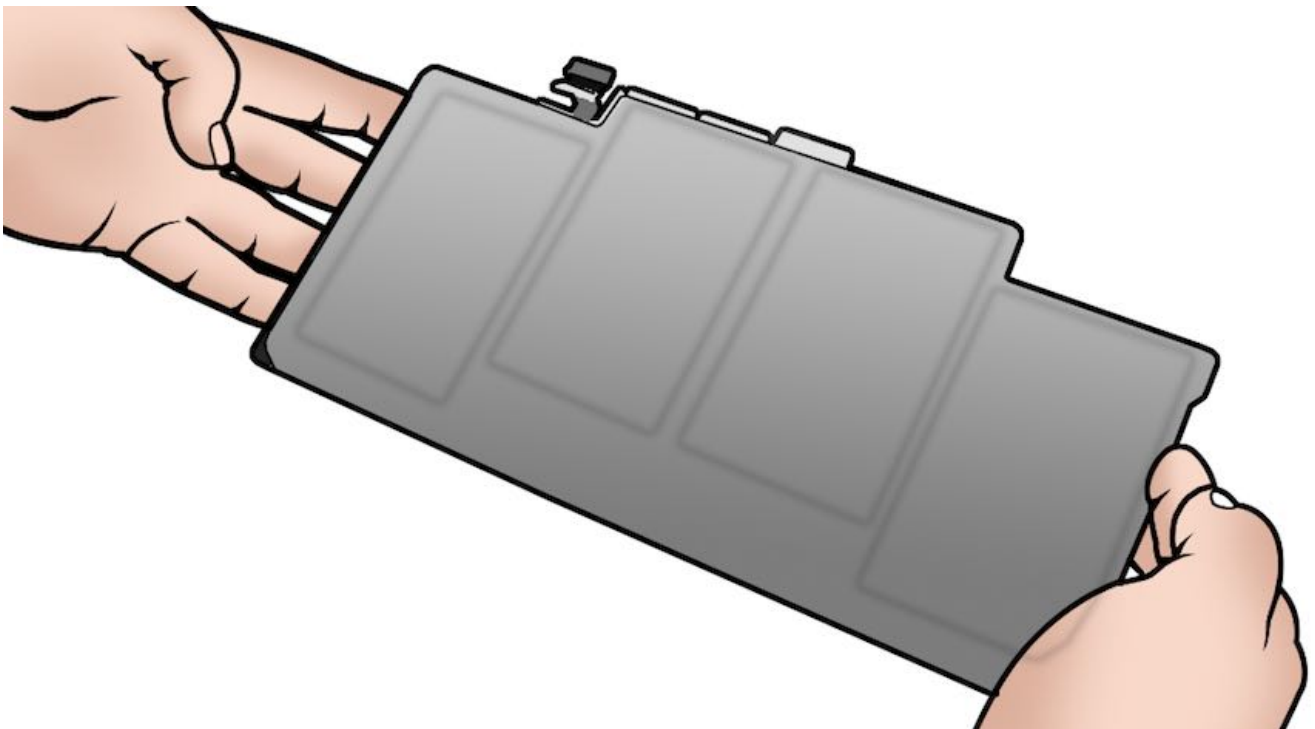


6. Handle battery by the edges only. Using battery cable, tilt covered battery out of computer.



7. Place covered battery (with cover up) on a clean surface free of dust, dirt, screws, or other debris.

8. If packaging battery for return, keep battery cover installed.



Steps For Reassembly

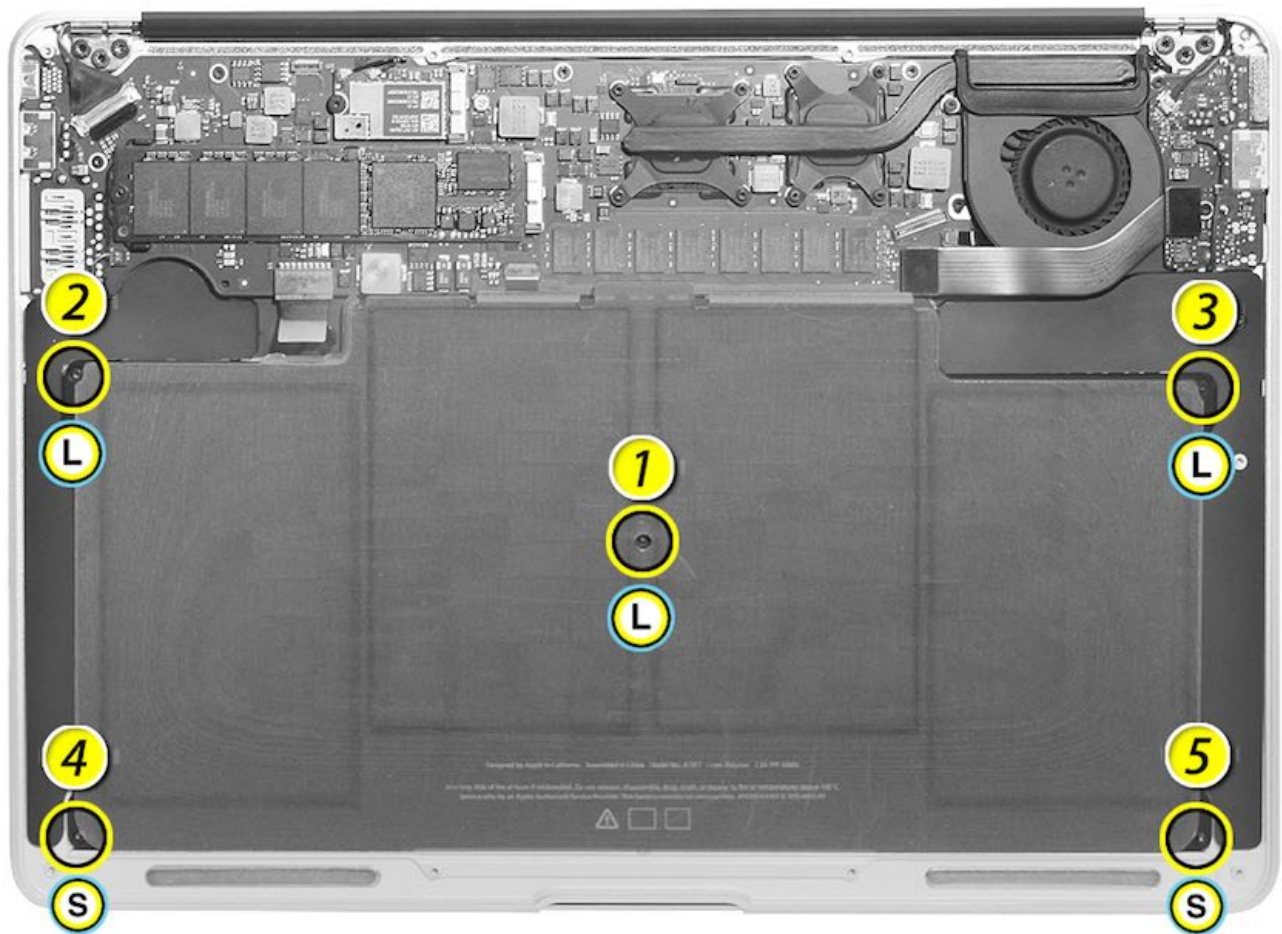
1. If installing new battery, unwrap it and make sure it has a battery cover. Do NOT use it if it does not have a cover. Contact ACS for further directions.
2. Before installing the battery, check that top case is clean — free of screws or other foreign material in the battery area.
3. Use two hands to place covered battery into top case.



4. Install five screws in order shown (longest screw at center and rear, shortest screws in front).

Note: Use a torque driver, if available, to tighten screws to 1.8 ± 0.18 Kgf-cm. If no torque driver is available, install screws finger tight.

Important: Handle screwdriver perpendicular to the battery cover to prevent damage to the battery.

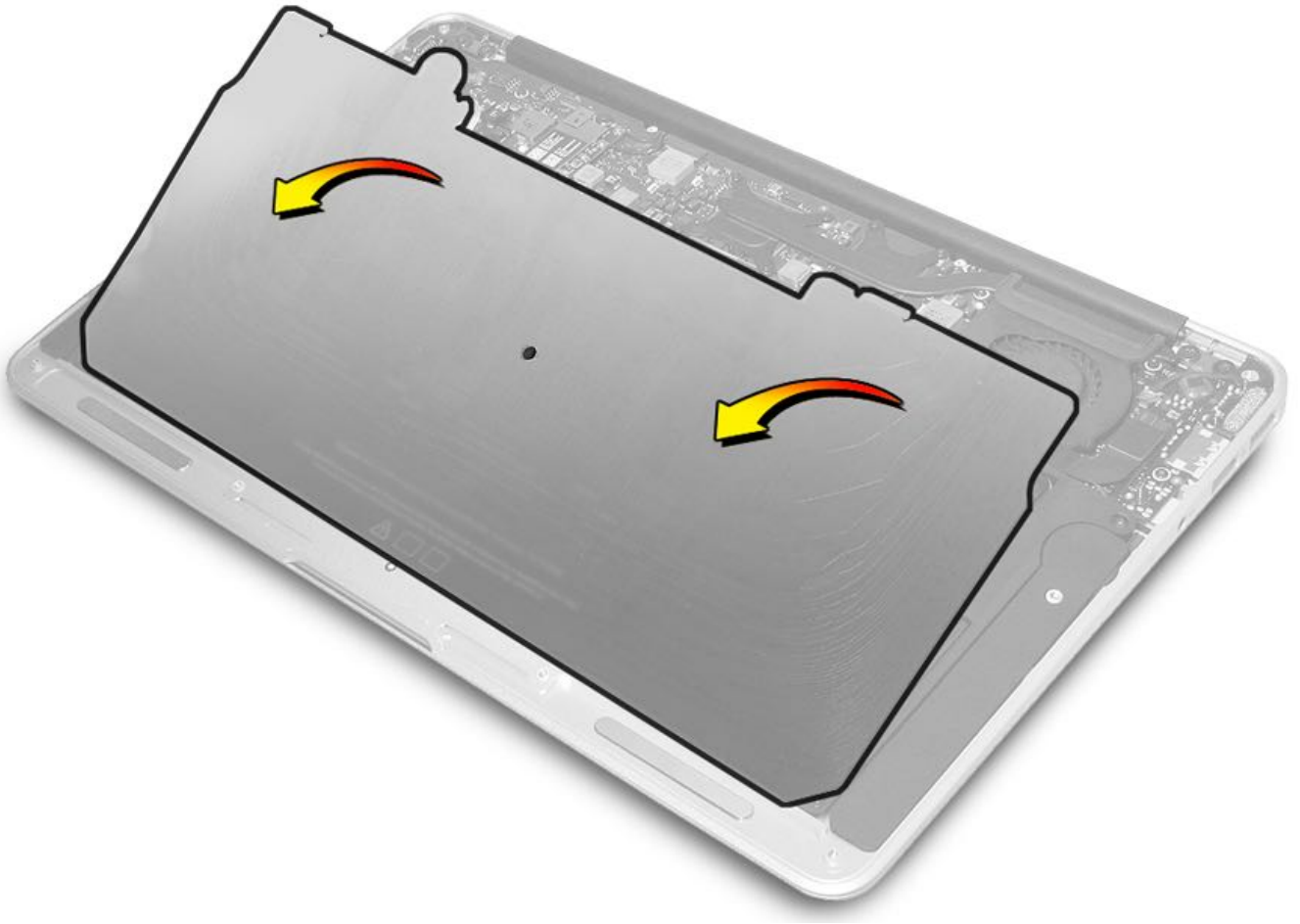


5. If performing other repairs, be sure to leave battery cable disconnected. Otherwise, connect battery cable to logic board.

6. Before installing bottom case, peel off battery cover.

Note: A clean battery cover can be reused for another repair if it is free of dust, dirt, or other debris.

7. Visually evaluate battery for damage.



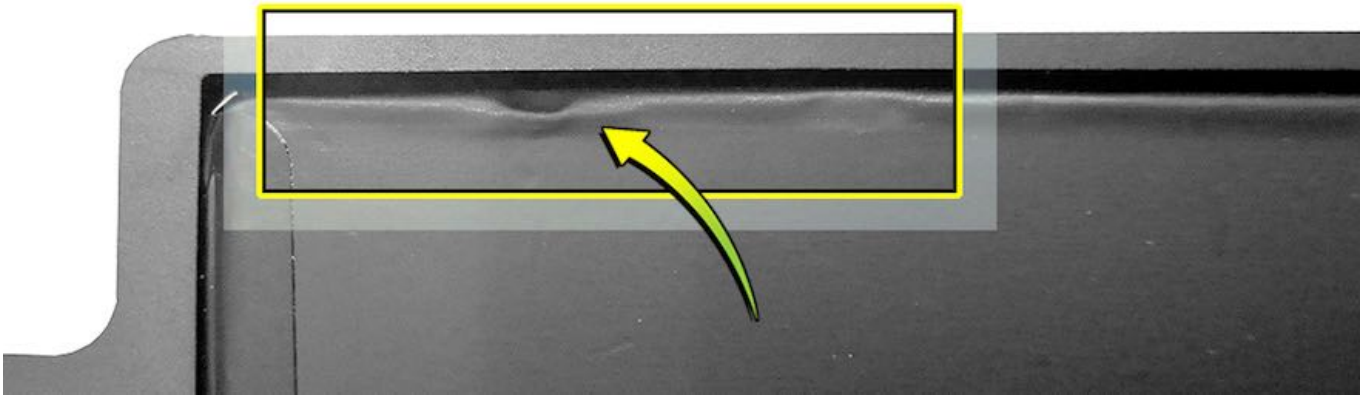
Evaluating Battery Damage

Use battery if:

- Minor dents
 - Up to eight dents if 0.4 mm deep or less
 - Up to five dents if 1.5 mm deep or less
 - Up to three dents if 2.0 mm deep or less

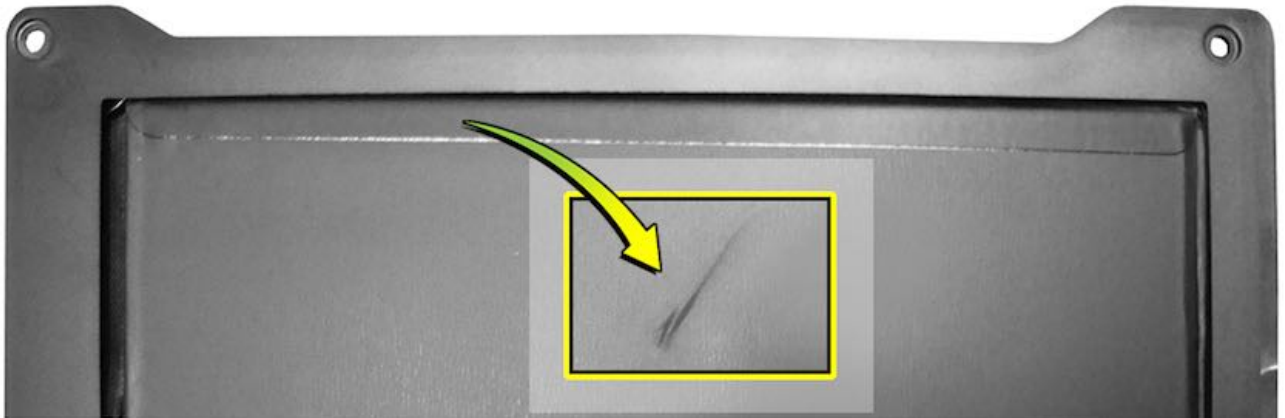


- Minor cell pack deformity (up to 2.0 mm total area)

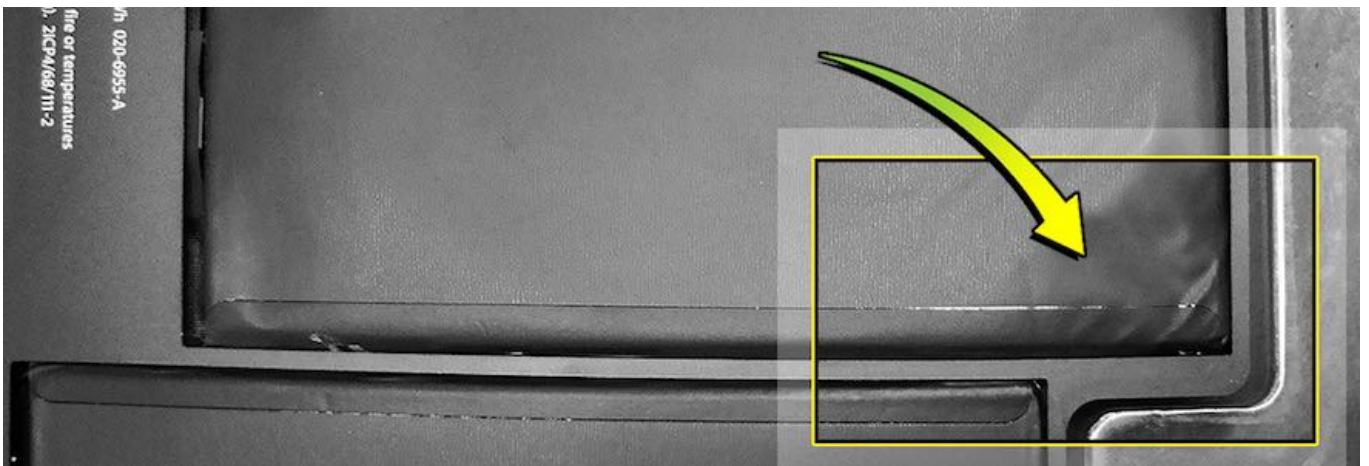


Return battery if:

- Scratches



- Swollen or wrinkled cell pack



Packing the Battery

Important: Do not discard battery packaging!

Both the inner and outer cardboard boxes used to ship a KGB battery must be used when returning a KBB battery. Follow the packing procedure below.

If either box has been damaged or lost, order a replacement service package (606-0090). The service package includes both the inner and outer cardboard boxes and an ESD bag. Reuse the battery cover that was included with the KGB battery or, if a new cover is needed, order part 922-9735.

1. Place protective cover on battery.



2. Place covered battery inside ESD bag.

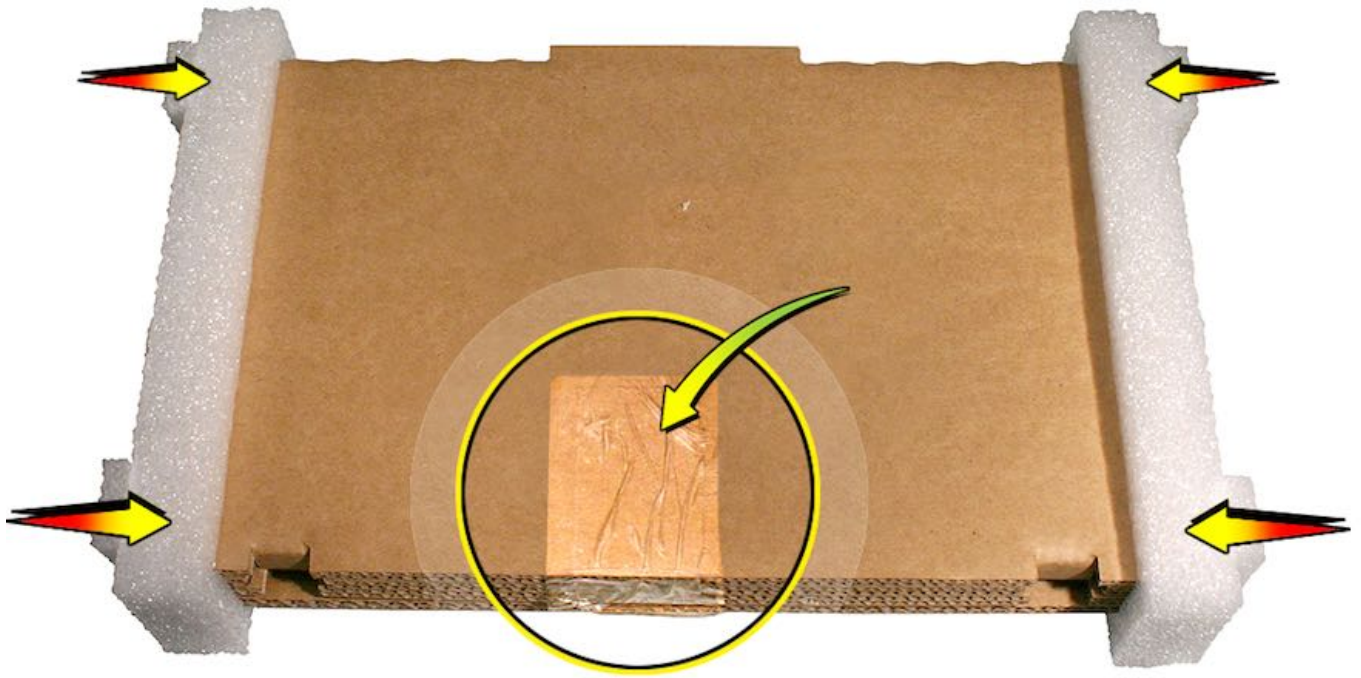


3. Carefully place covered and wrapped battery in cardboard packing material.



4. Close inner box. Attach foam end pieces on box and tape the box closed.

Note: The packing MUST be taped closed. Any tape will work. Do not use staples, as they can puncture the battery.



5. Carefully place taped box into shipping box.

6. Close box and return battery using normal shipping procedures.

Note: As with shipping any battery, IATA compliance is a must. See article [HT204643: Prepare shipments of lithium batteries and battery-powered equipment](#).



Right Speaker

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to article [SV161: Right Speaker Replacement Video](#) (Mid 2012 to 2017).

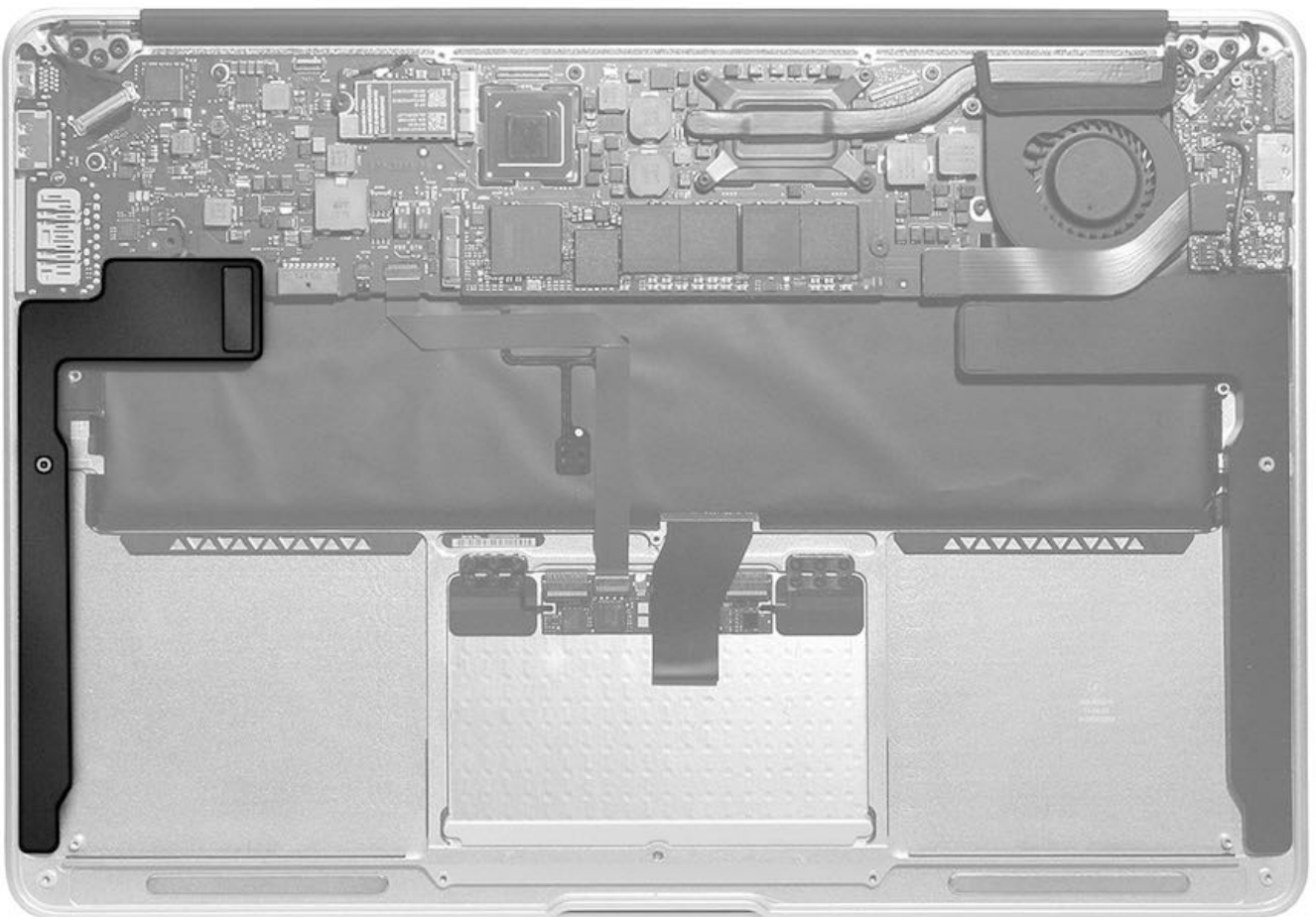
Remove:

- [Bottom Case](#)
- [Battery](#)



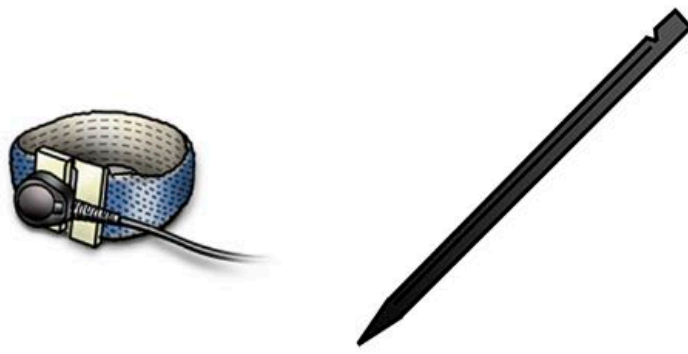
Important: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board.

Caution: Read [Battery Safety Precautions](#) before performing this procedure.



Tools

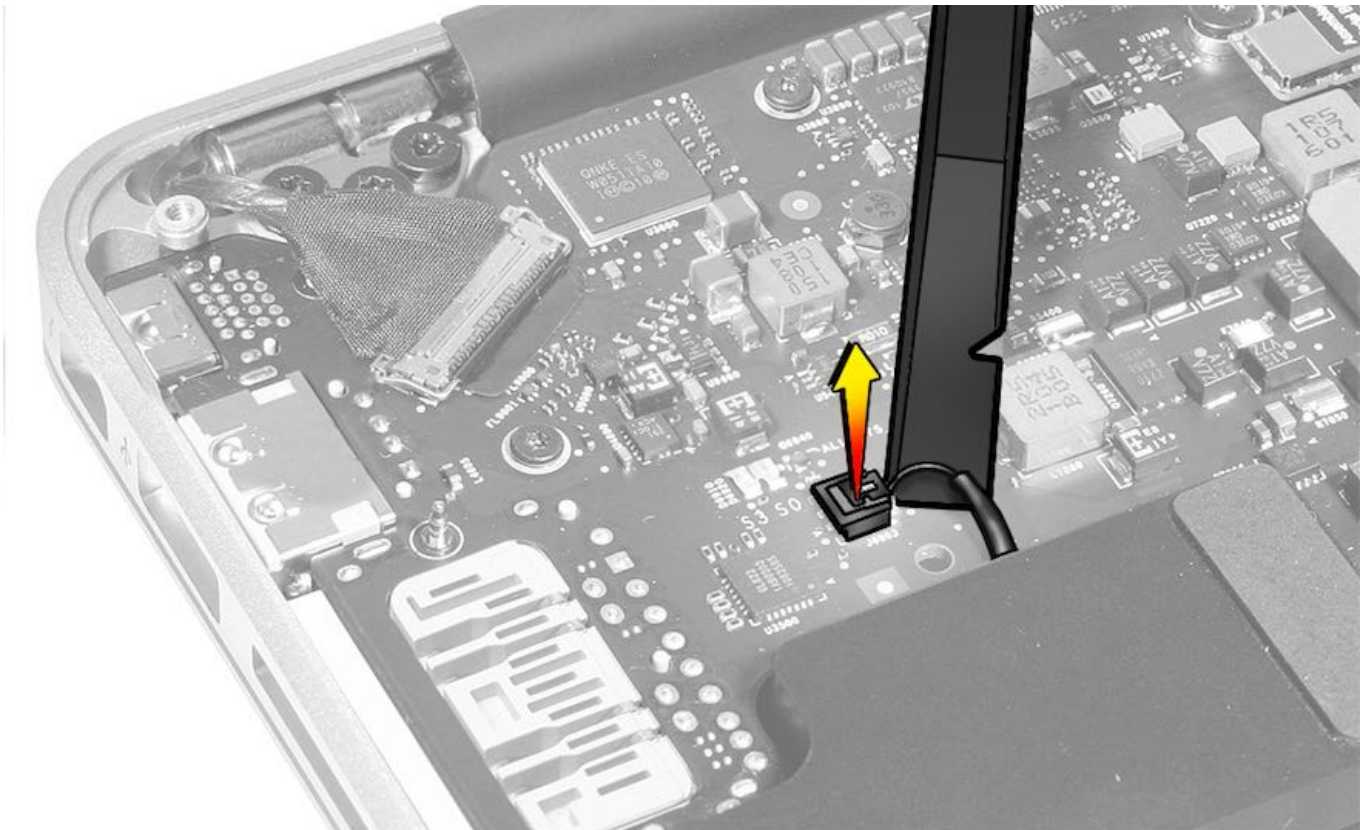
- ESD wrist strap
- Black stick



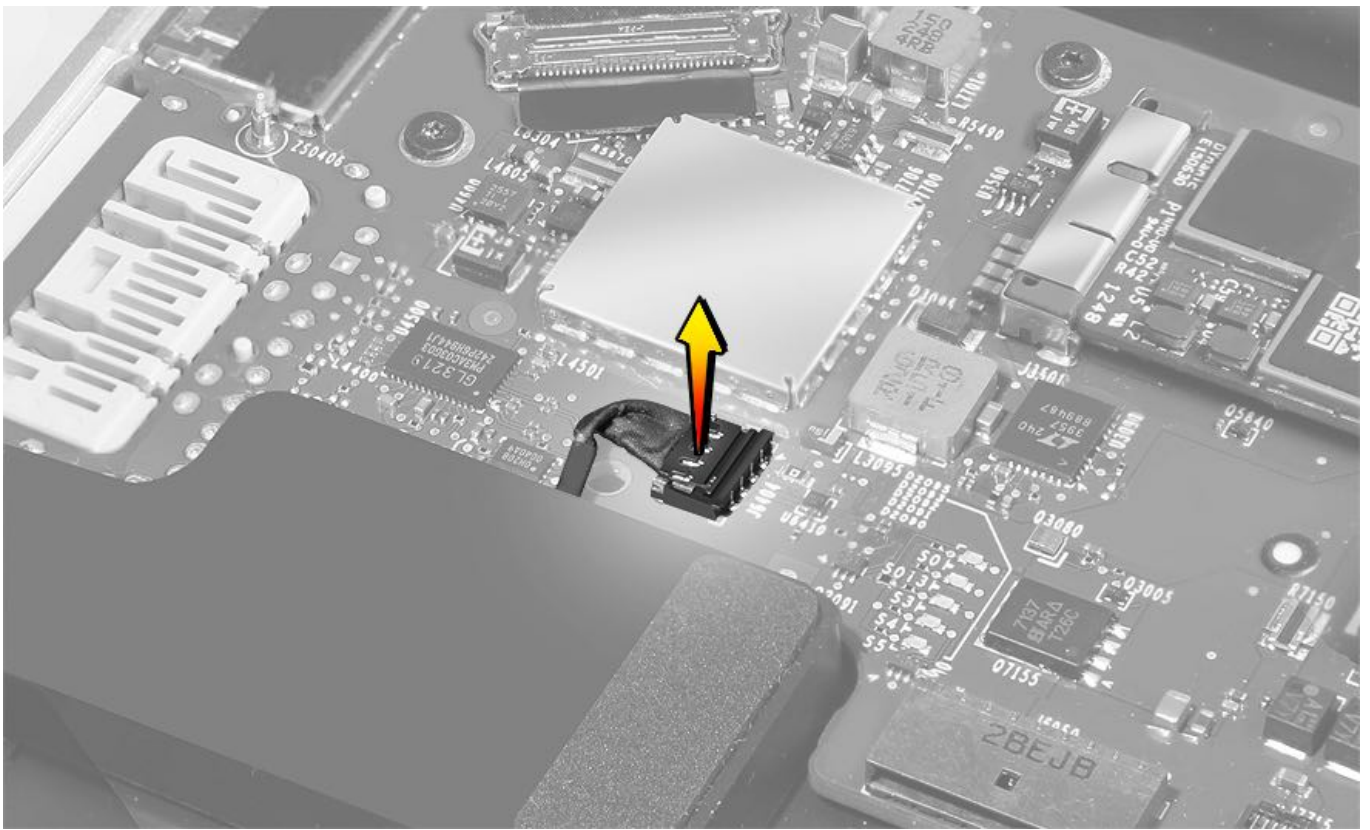
Steps For Removal

1. Use black stick to disconnect vertical insertion cable from logic board.

MacBook Air (13-inch, Mid 2011 and Mid 2012)

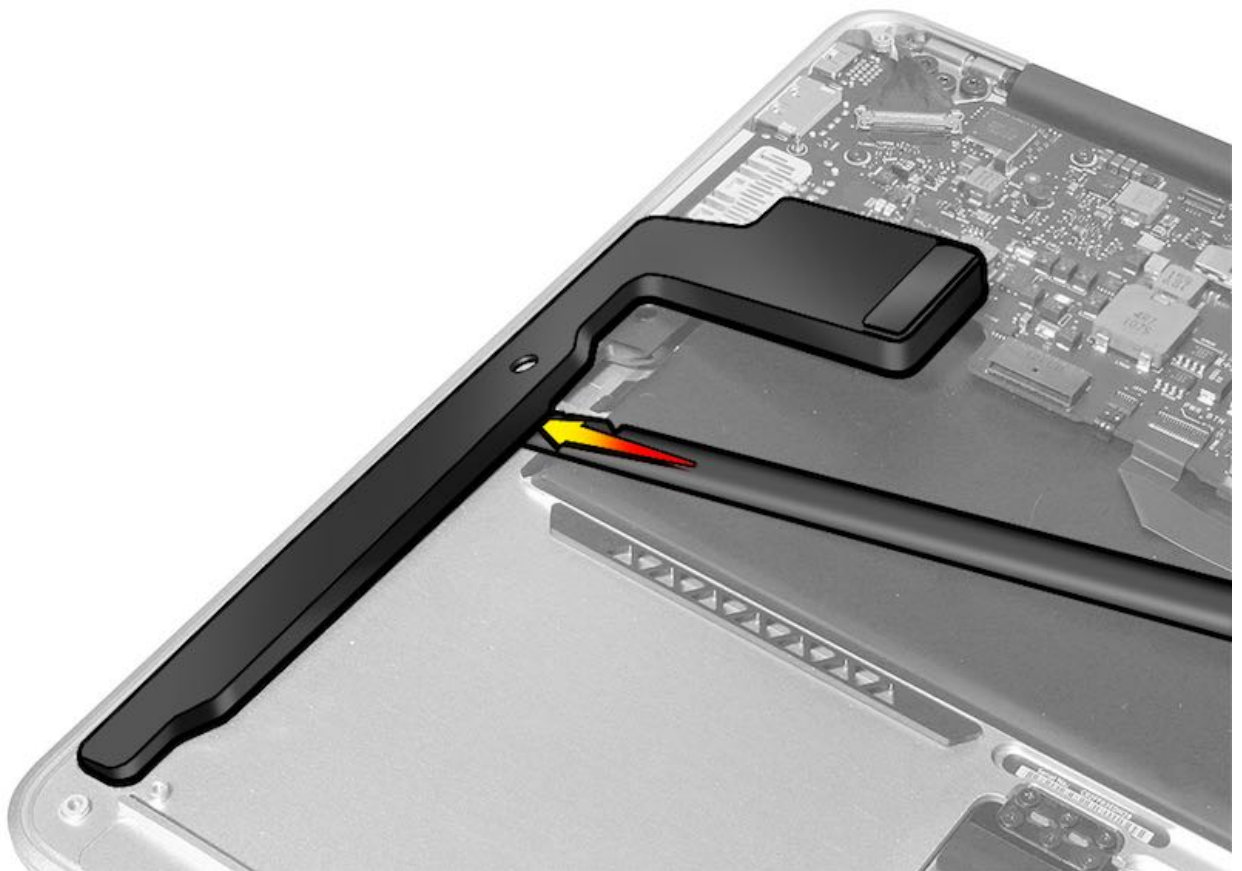


MacBook Air (13-inch, Mid 2013, Early 2014, Early 2015, 2017)



2. Use black stick to pry very high bond (VHB) adhesive securing speaker to top case.

Note: The MacBook Air (Early 2015 and 2017) right and left speaker (923-00506) are replaced as a pair.



Steps For Reassembly

1. Make sure top case is free of residual VHB adhesive if installing new speaker.
2. Peel adhesive backing off speaker body and install speaker into top case.
3. Apply some pressure to make sure speaker adheres to top case.

4. Connect cable and replace screw.

Left Speaker

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to article [SV162: Left Speaker Replacement Video](#) (Mid 2012 to 2017).

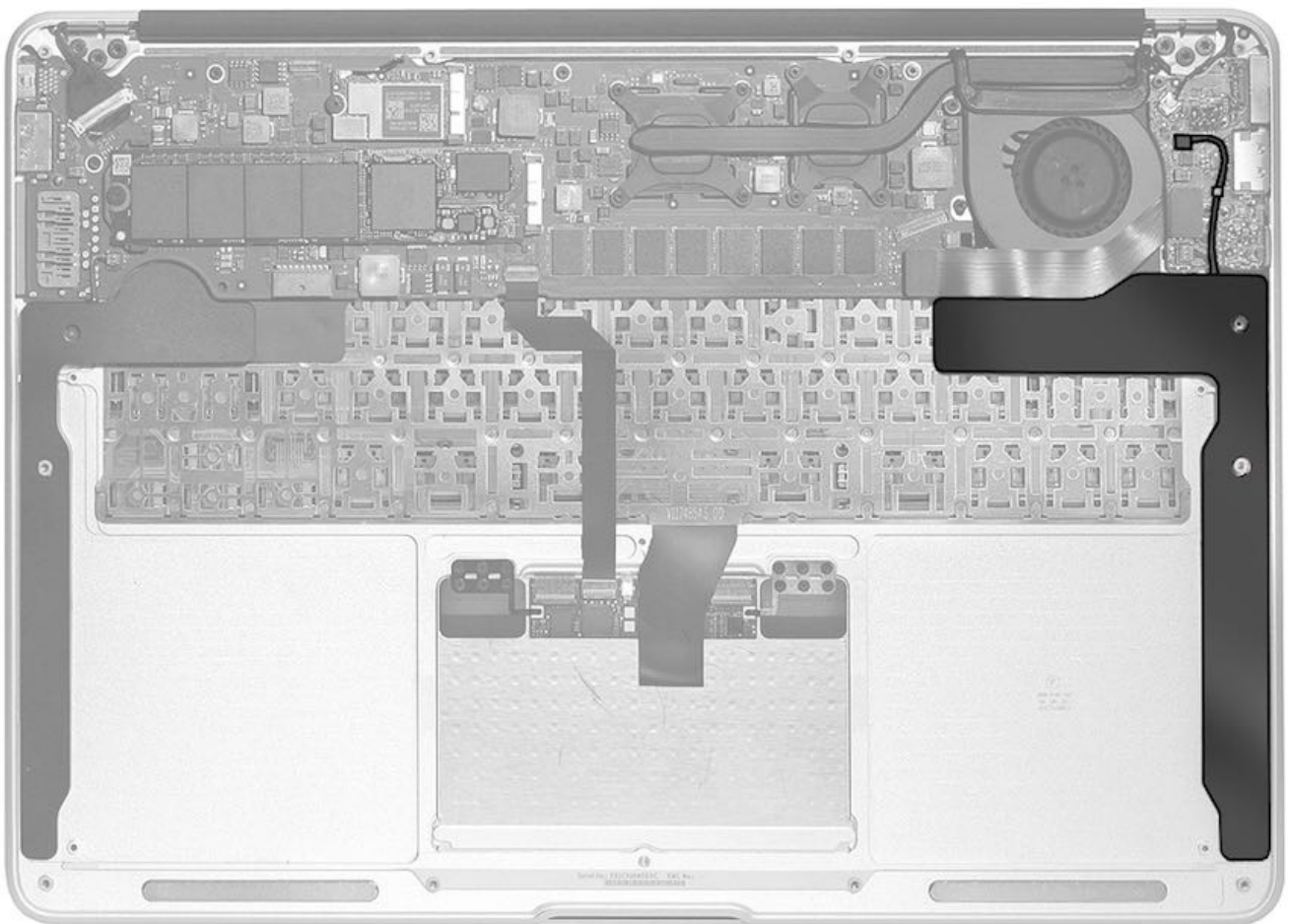
Remove:

- [Bottom Case](#)
- [Battery](#)



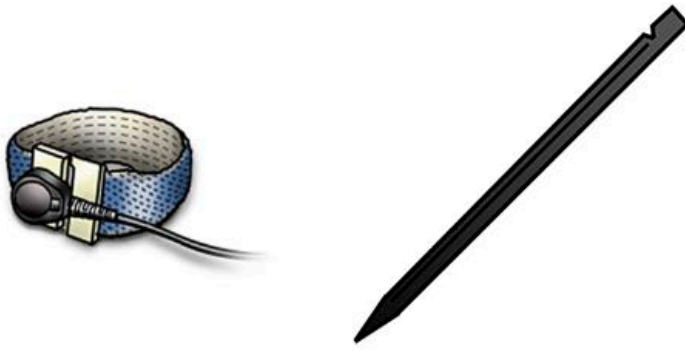
Important: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board.

Caution: Read [Battery Safety Precautions](#) before performing this procedure.



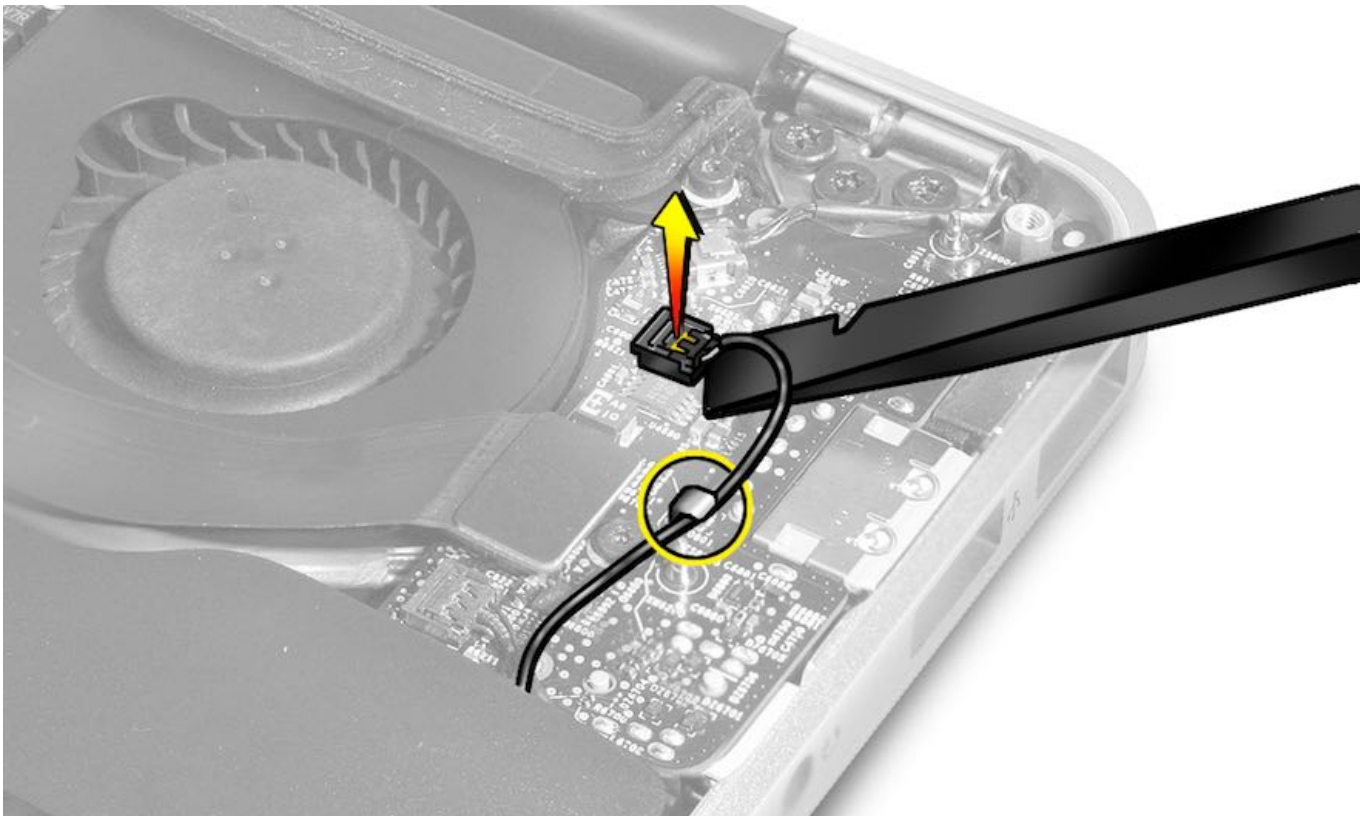
Tools

- ESD wrist strap
- Black stick



Steps For Removal

1. Use black stick to disconnect vertical insertion cable from I/O board.
2. Release speaker cable from clip, if present.



3. Use black stick to pry very high bond (VHB) adhesive securing speaker to top case.

Note: The MacBook Air (Early 2015 and 2017) right and left speaker (923-00506) are replaced as a pair.



Steps For Reassembly

Important: Use only the adhesive preinstalled on the new speaker. **The adhesive must lie flat in a single layer.** Do not double up speaker/top case adhesive.

Important: After replacing a Mid 2013, Early 2014, Early 2015, or 2017 trackpad, you must use Trackpad Keyboard Mapper to ensure the trackpad is coded to match keyboard version.

- For Mid 2013 and Early 2014 models, refer to article [TP1016: AST Reference Guide: Using the Trackpad Keyboard Mapper](#).
- For Early 2015 and 2017 models, use the Trackpad Keyboard Mapper in AST 2. For more information about AST 2, refer to article [TP1105: AST 2 for Mac Reference Guide](#).

1. Make sure top case is free of residual VHB adhesive if installing new speaker.
2. Peel adhesive backing off speaker body and install speaker into top case.
3. Apply some pressure to make sure speaker adheres to top case.
4. Route cable under retaining clip, if present, and connect cable I/O board.

Solid-State Drive (SSD) Card or Flash Storage

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to articles:

- [SV170: Flash Storage Replacement Video](#) (Mid 2012)
- [SV153: Flash Storage Replacement Video](#) (Mid 2013, Early 2014, Early 2015, 2017)

Remove:

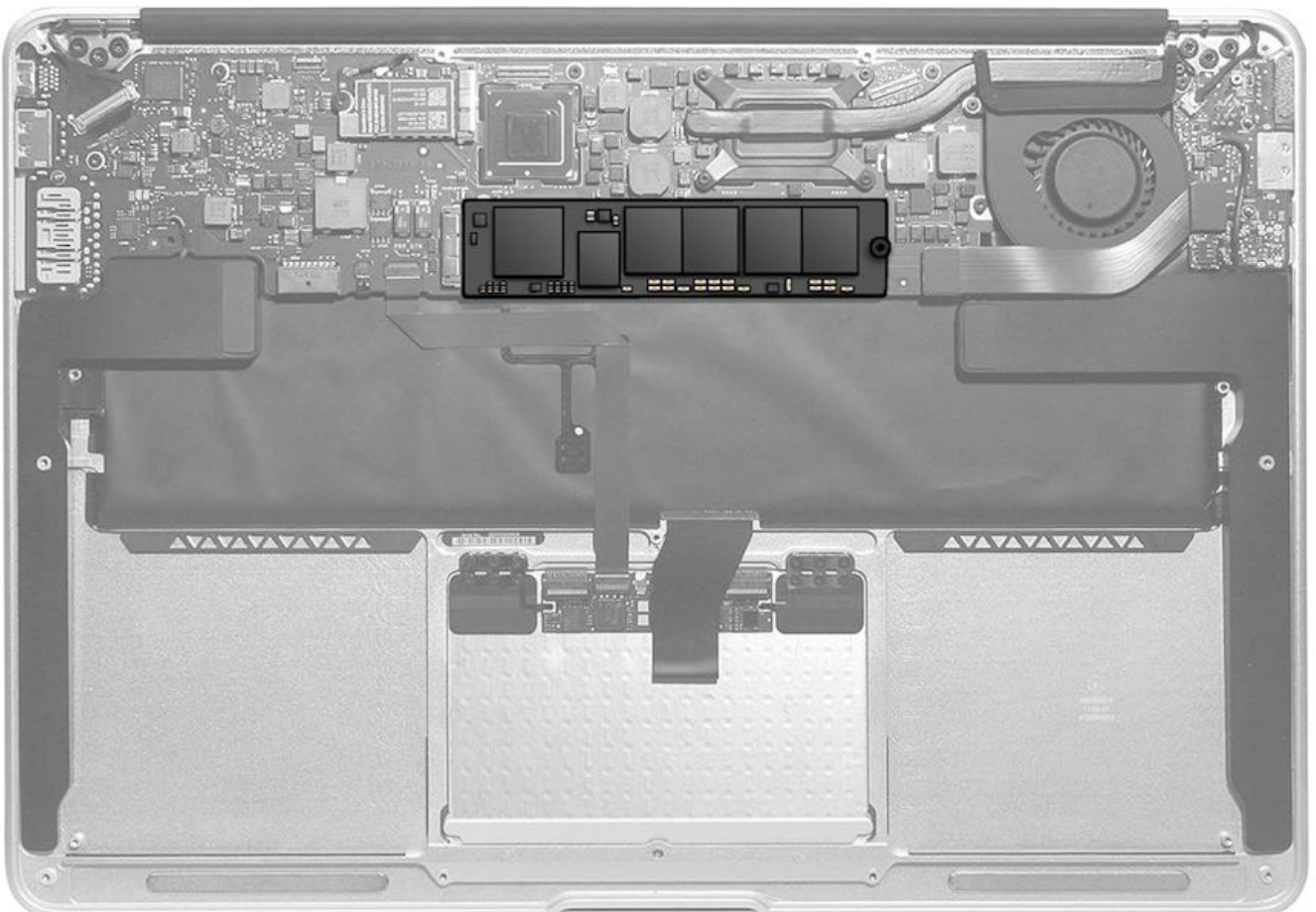
- [Bottom Case](#)



Important: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board.

Caution: Read [Battery Safety Precautions](#) before performing this procedure.

Caution: Make sure data is backed up before removing SSD card or flash storage.



Tools

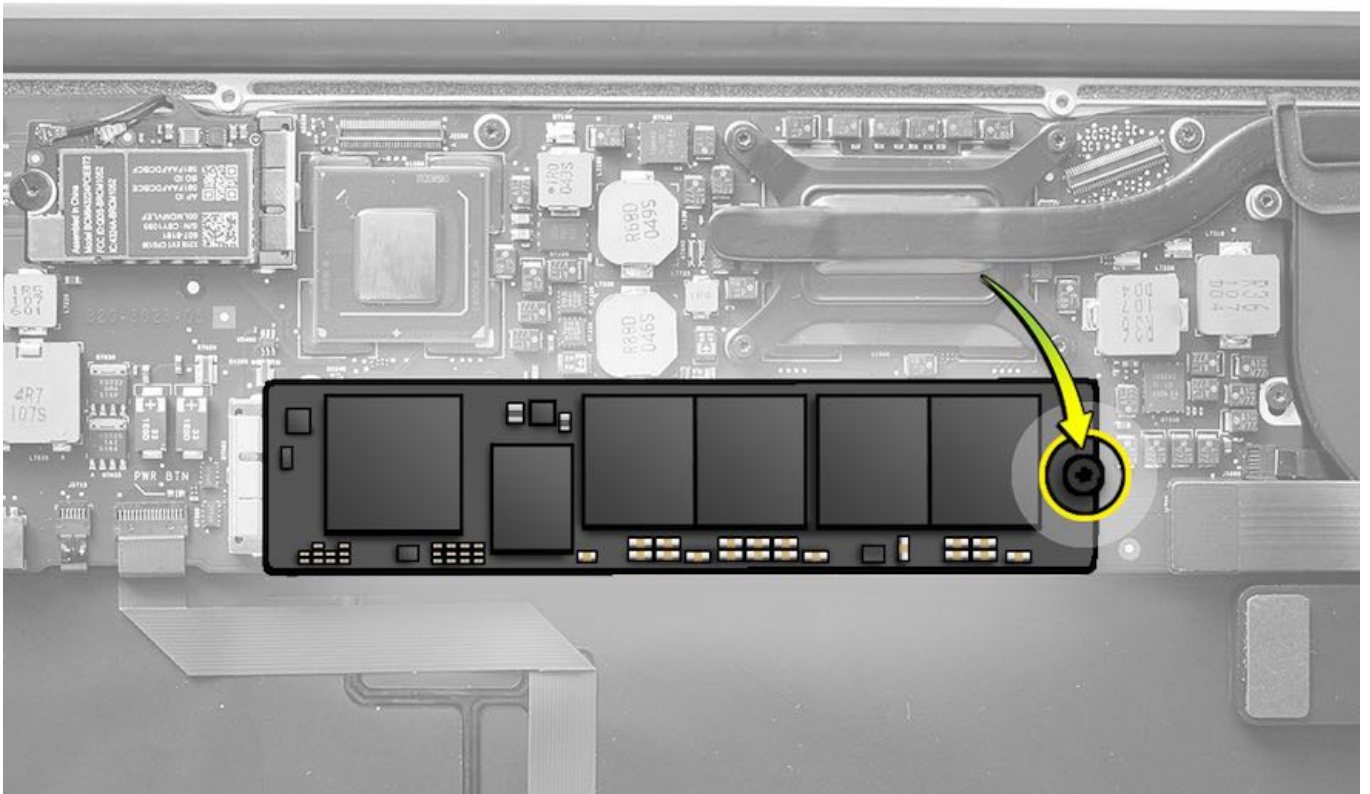
- ESD wrist strap
- Torx T5 screwdriver, magnetized



Steps For Removal

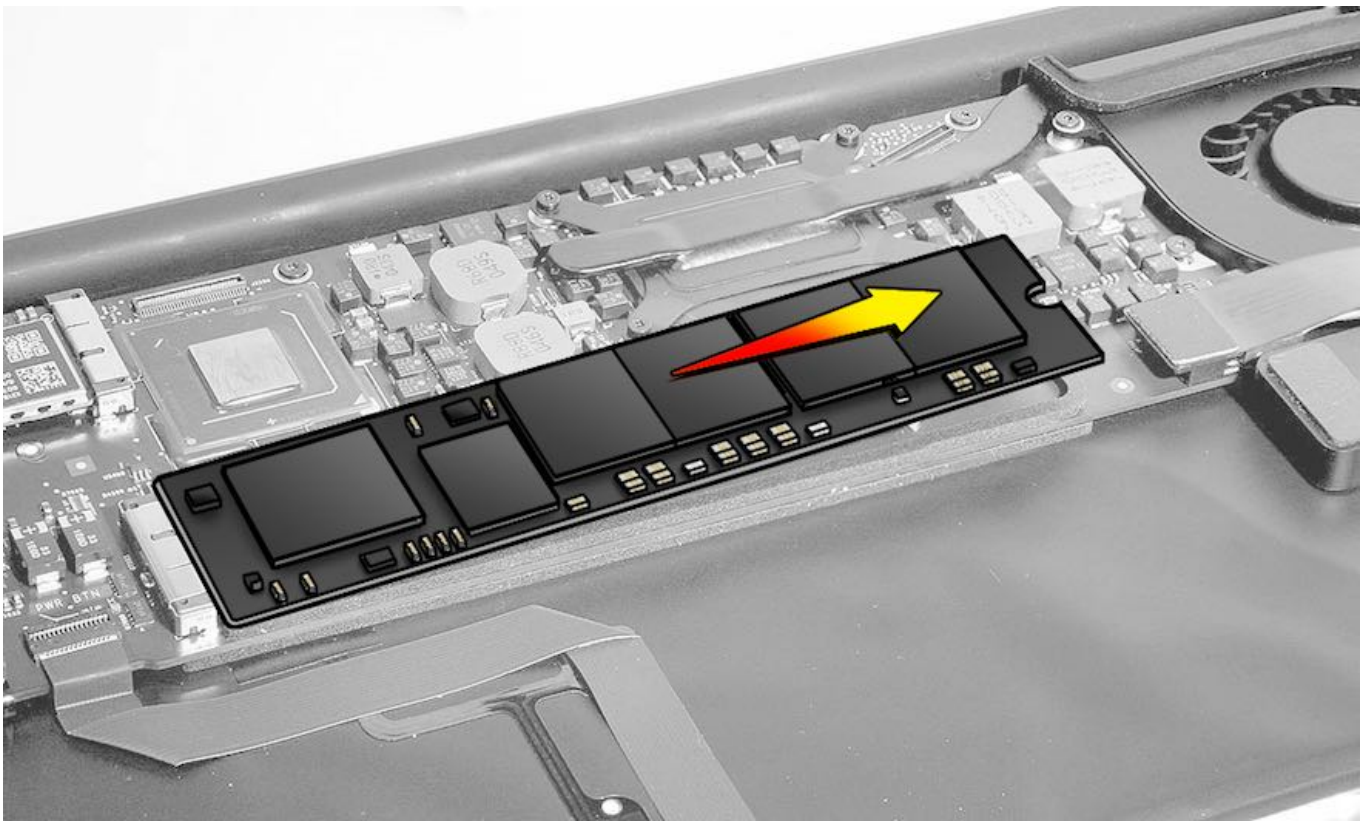
1. Remove the T5 screw that secures the SSD card or flash storage to the logic board.

- T5: 922-9651, 2.85 mm



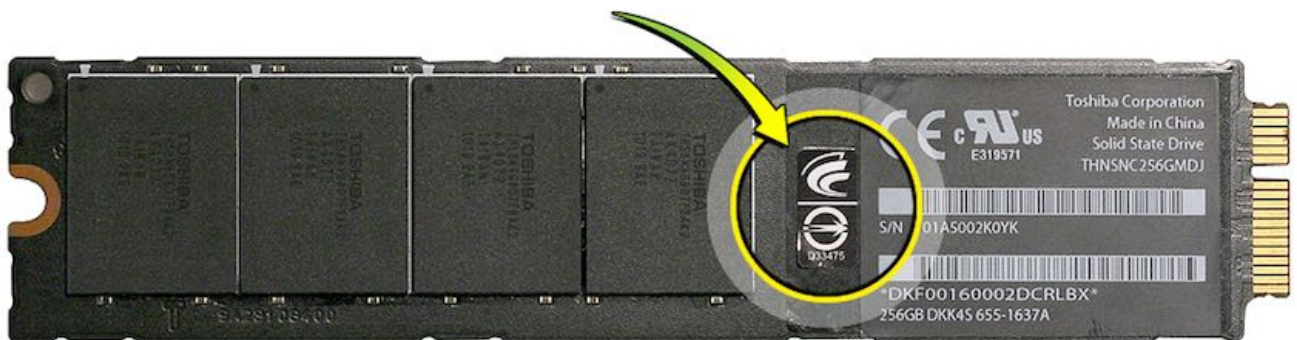
2. Tilt up flash storage at a slight angle (< 3 degrees) and gently pull it to disconnect it from logic board.

Reassembly Note: Push flash storage securely into slot confirming that it is seated properly.



Steps For Reassembly

Replacement Note: Before installing a new SSD card or flash storage into the computer, peel off and discard the import compliance label, if present. This label is required to import the service part into certain countries, but is no longer relevant once the part is installed into a computer.



Reinstalling Software That Came with the Computer

Reinstalling Software That Came with the Computer

This procedure requires an Internet connection.

Note: In some situations, a user may have set a firmware password via a feature such as Find My Mac or FileVault. The user must know the firmware password in order to reinstall OS X or macOS. If the user cannot remember the password, then refer to the technician instructions in article [HT203409: If you lost or forgot your firmware password](#).

Important: Apple recommends that users back up their data before any software restore procedure. Back up essential files before installing OS X or macOS. Apple is not responsible for any loss of data.

1. Choose Apple menu > Restart, then hold down the Command (⌘) and R keys while the computer restarts.
Note: To force OS X Lion or later, or macOS Sierra, into Internet Recovery, press and hold the Command-Option-R key combination while starting up the computer.
2. If the computer is not connected to the Internet, choose a network from the Wi-Fi menu (in the top-right corner of the screen).
3. Select "Reinstall OS X" (or macOS), then click Continue.
4. Follow the onscreen instructions. In the pane where you select a disk, select your current OS X or macOS disk (in most cases, it is the only one available).
5. To start the installation, click Install.

Check for and apply the latest software and firmware updates.

For more information, refer to article [HT201314: About macOS Recovery](#).

Wireless Card

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to article [SV154: Wireless Card Replacement Video](#).

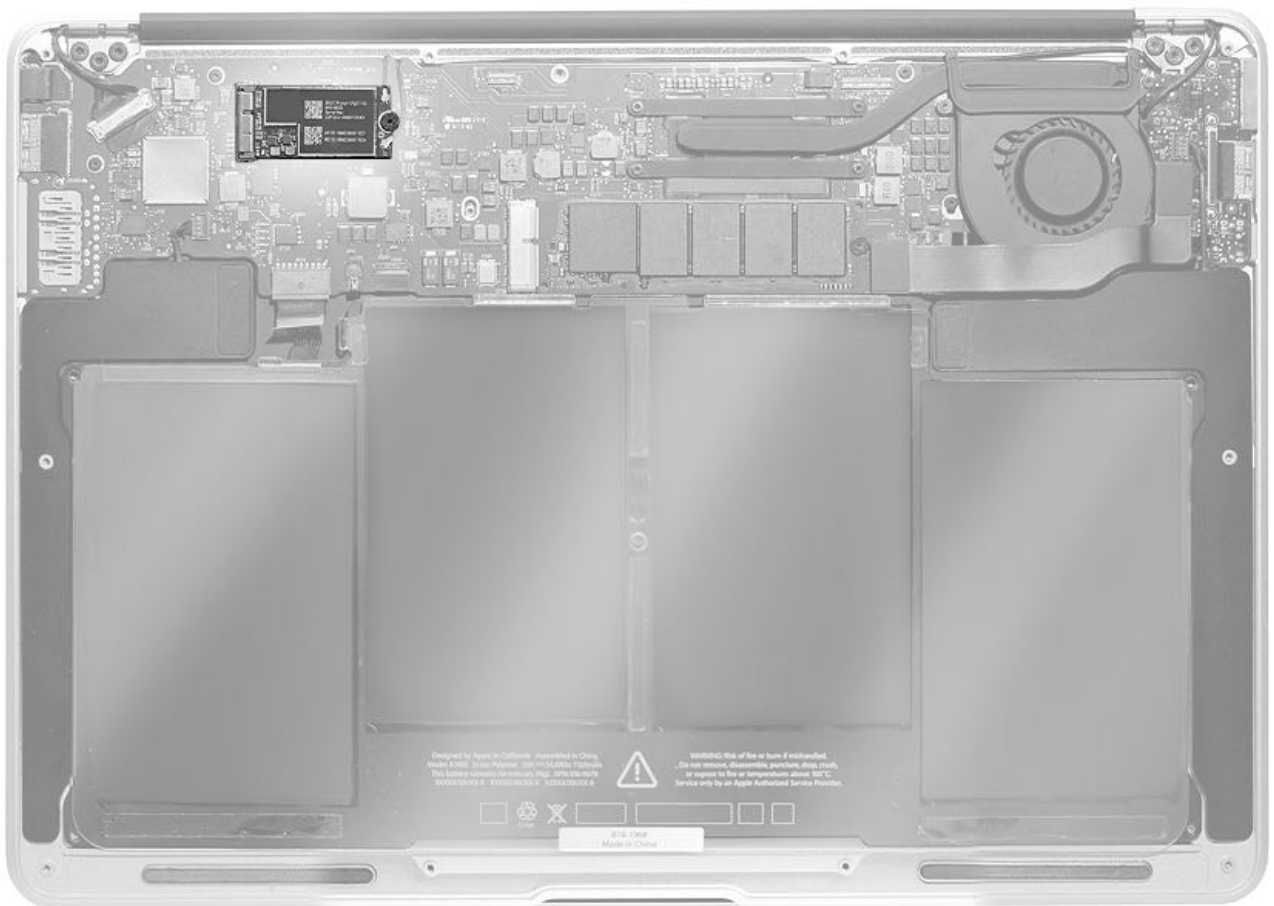
Remove:

- [Bottom Case](#)



Important: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board.

Caution: Read [Battery Safety Precautions](#) before performing this procedure.



Tools

- ESD wrist strap
- ESD-safe tweezers
- Torx T5 screwdriver, magnetized



Steps For Removal

Caution: Avoid stressing antenna cables when disconnecting them.

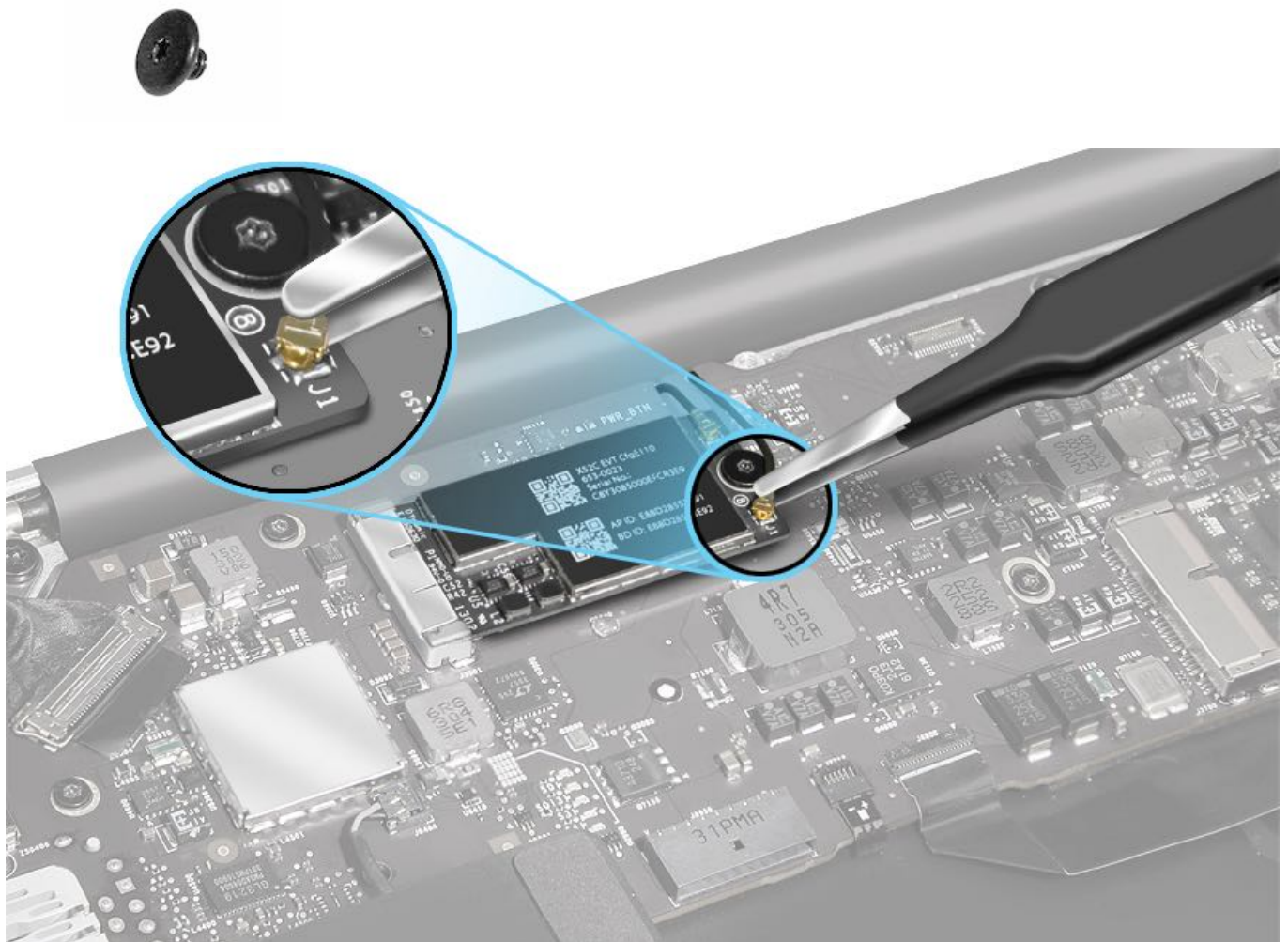
1. Using EMI-safe tweezers, carefully grip antenna cable on metal extension behind connector head and gently pop cable straight up off card.

Note: If cable has not been previously disconnected, you may have to apply additional force.

2. Repeat for second antenna cable.

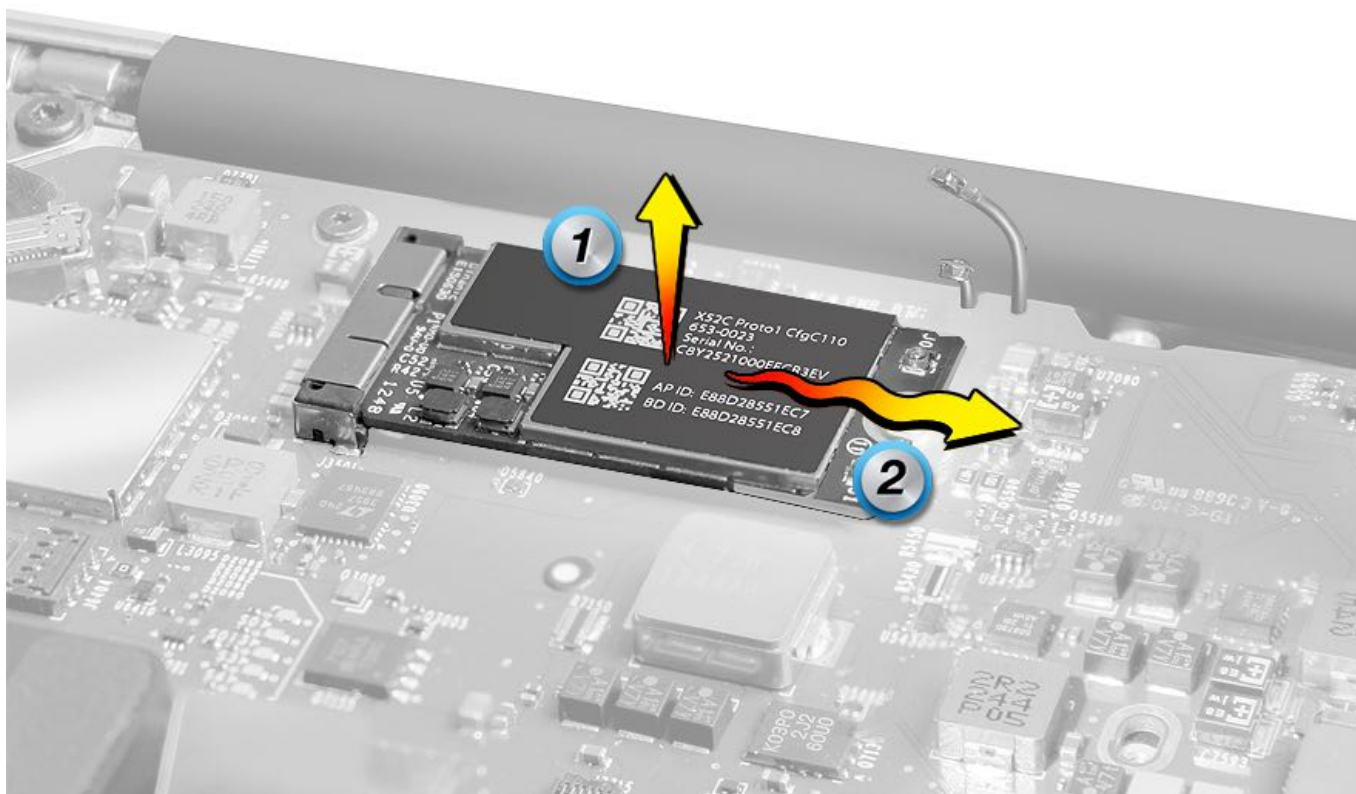
3. Remove the T5 screw that secures the wireless card to the logic board.

- T5: 922-9651, 2.85 mm



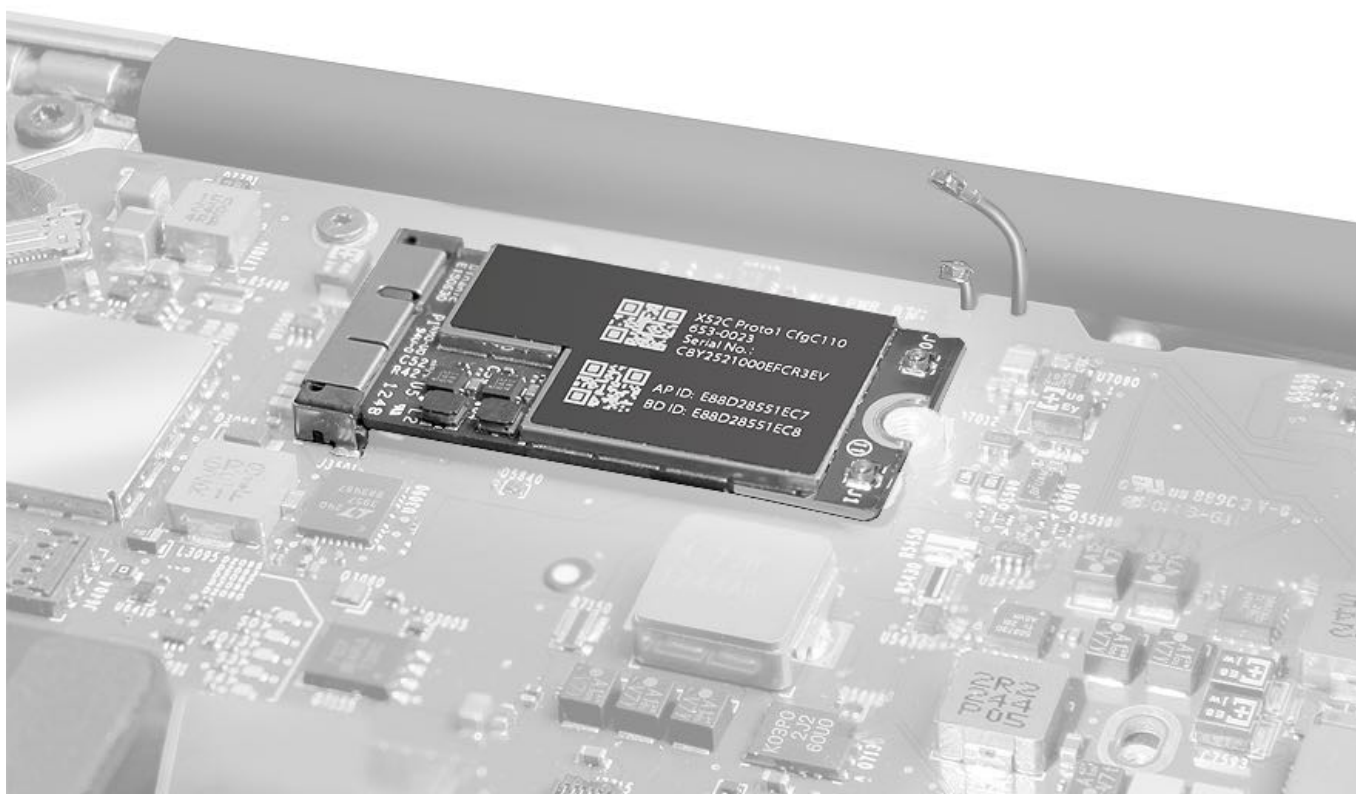
4. With your fingers, slightly tilt up card (enough to clear screw standoff).

5. Rock and pull card to disconnect it from logic board connector.

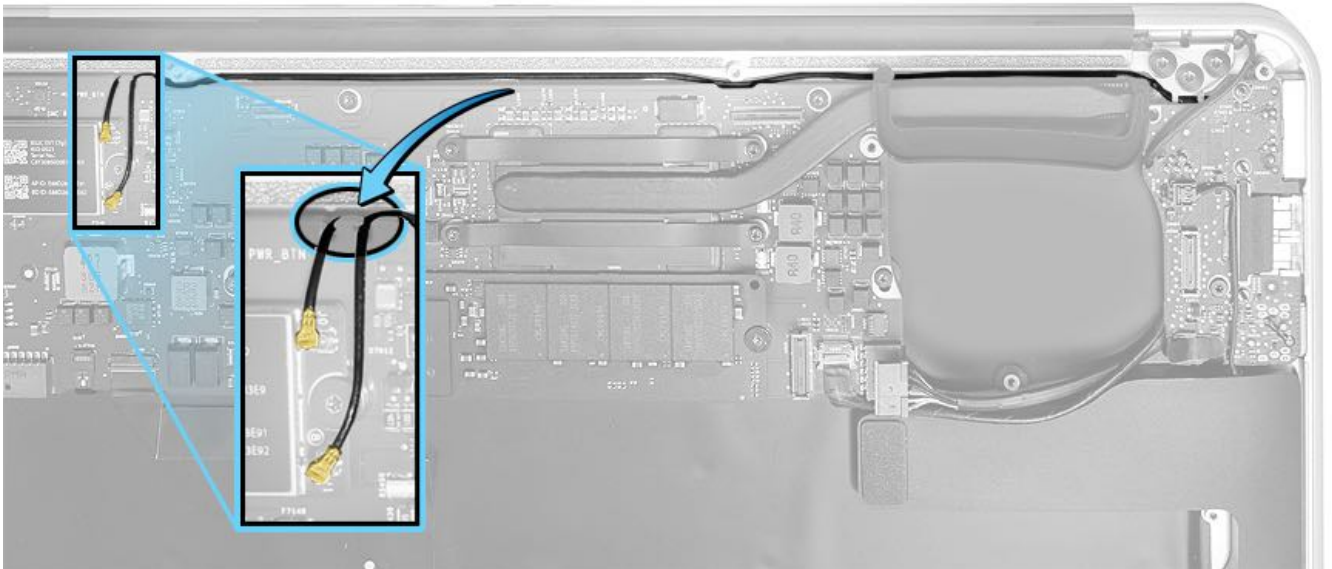


Steps For Reassembly

1. Insert card into connector until no pins are visible.



Note: Check that antennas are properly routed through notches in logic board.

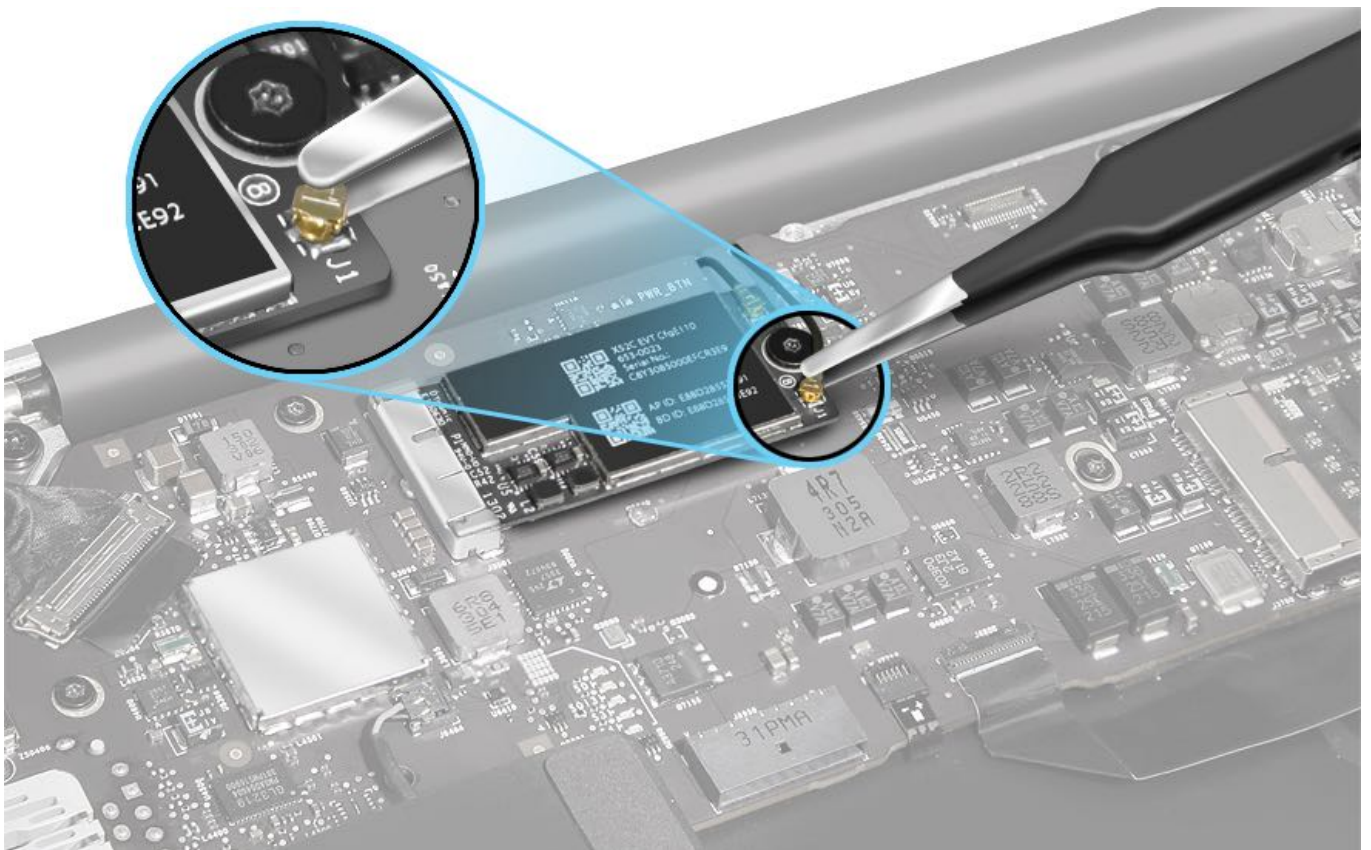


2. Using tweezers, position antenna head over connector until you feel it seat with connector. Carefully press straight down with a finger until head snaps into place.

Caution: Using too much force to reseat antenna cables can bend or damage connector or connector rim.

3. Reinstall the T5 screw that secures the wireless card to the logic board.

- T5: 922-9651, 2.85 mm



Input/Output (I/O) Flex Cable

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to article [SV163: I/O Flex Replacement Video](#) (Mid 2012 to 2017).

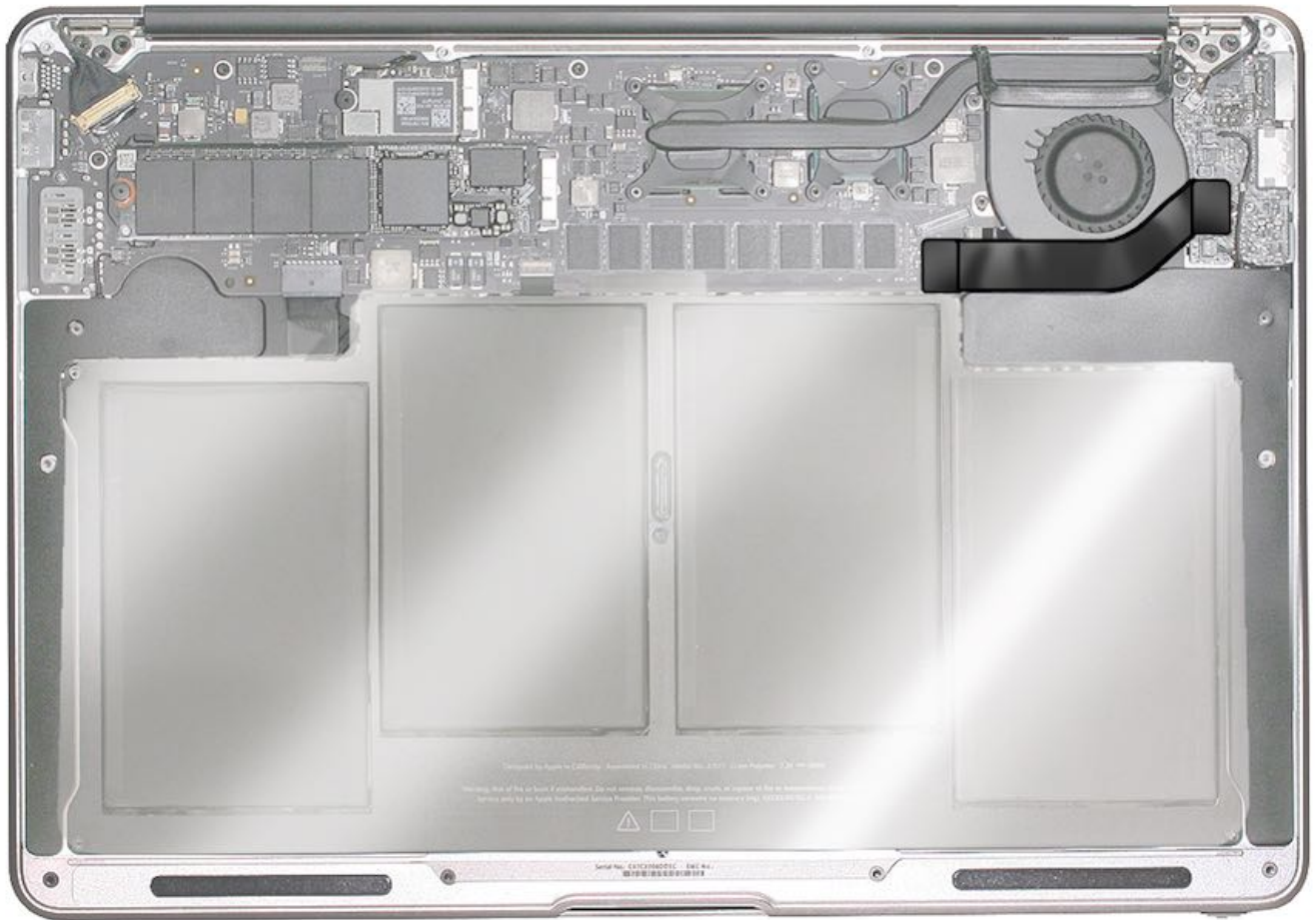
Remove:

- [Bottom Case](#)



Important: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board.

Caution: Read [Battery Safety Precautions](#) before performing this procedure.



Tools

- ESD wrist strap
- Black stick

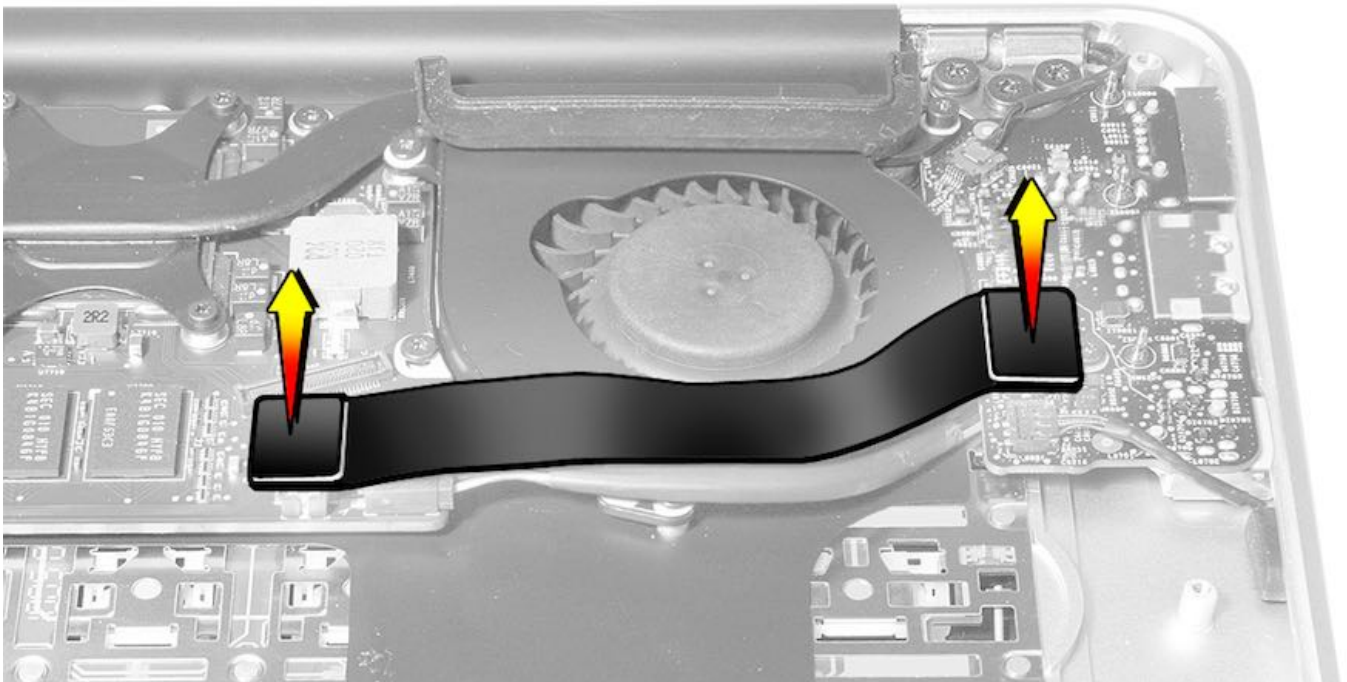


Steps For Removal

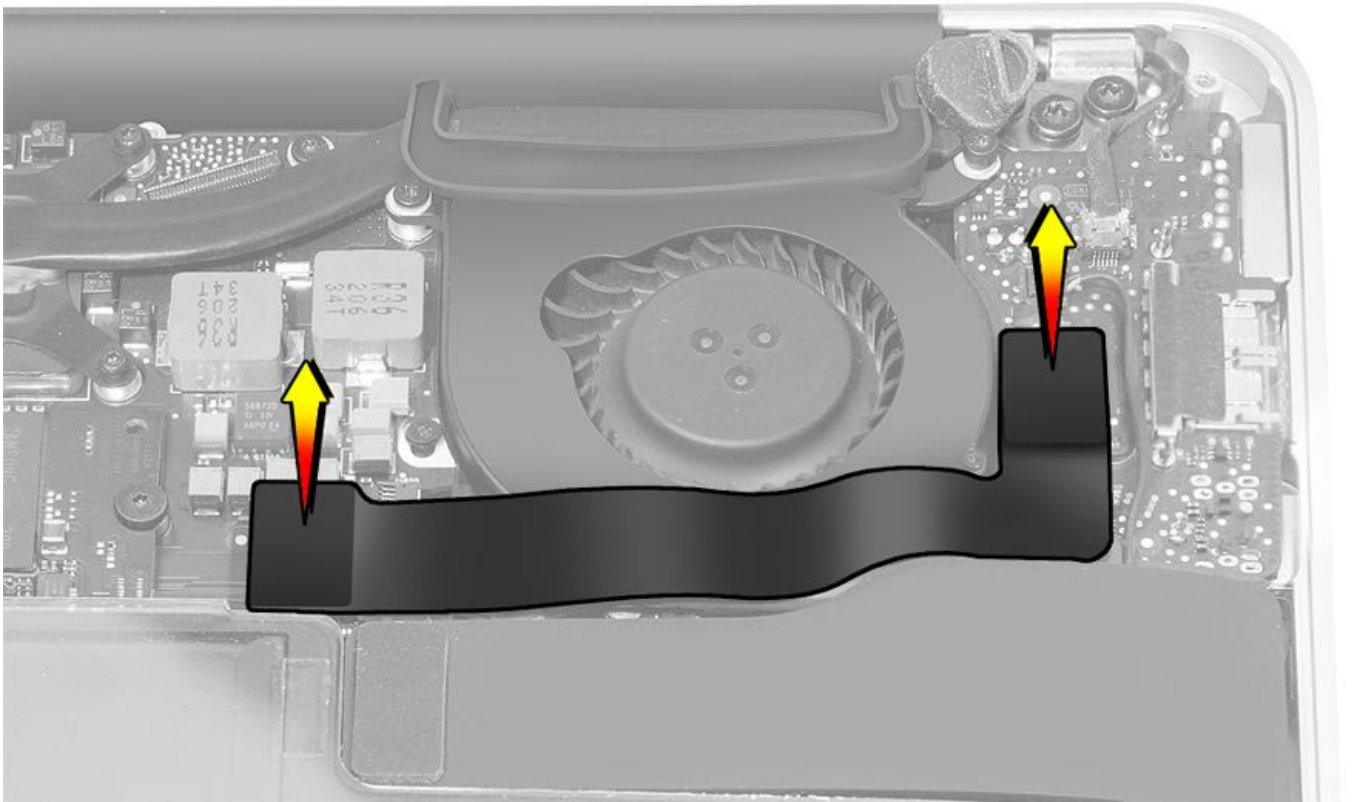
1. Remove cable in straight vertical motion from connectors.

Reassembly Note: Check for pin deformation on logic or I/O board connectors before inserting cable. Press firmly on each end of cable to securely attach connector to the boards.

Late 2010 and Mid 2011



Mid 2012, Mid 2013, Early 2014, Early 2015, 2017



Note: I/O cable has a liquid contact indicator (LCI) on underside.

Late 2010 and Mid 2011



Mid 2012, Mid 2013, Early 2014, Early 2015, 2017



Steps For Reassembly

Replacement Note: For more information on reseating the I/O flex cable, refer to article [OP490: Alignment and reseating of LIO Flex Cable](#).

Fan

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to articles:

- [SV172: Fan Replacement Video](#) (Mid 2012)
- [SV155: Fan Replacement Video](#) (Mid 2013, Early 2014, Early 2015, 2017)

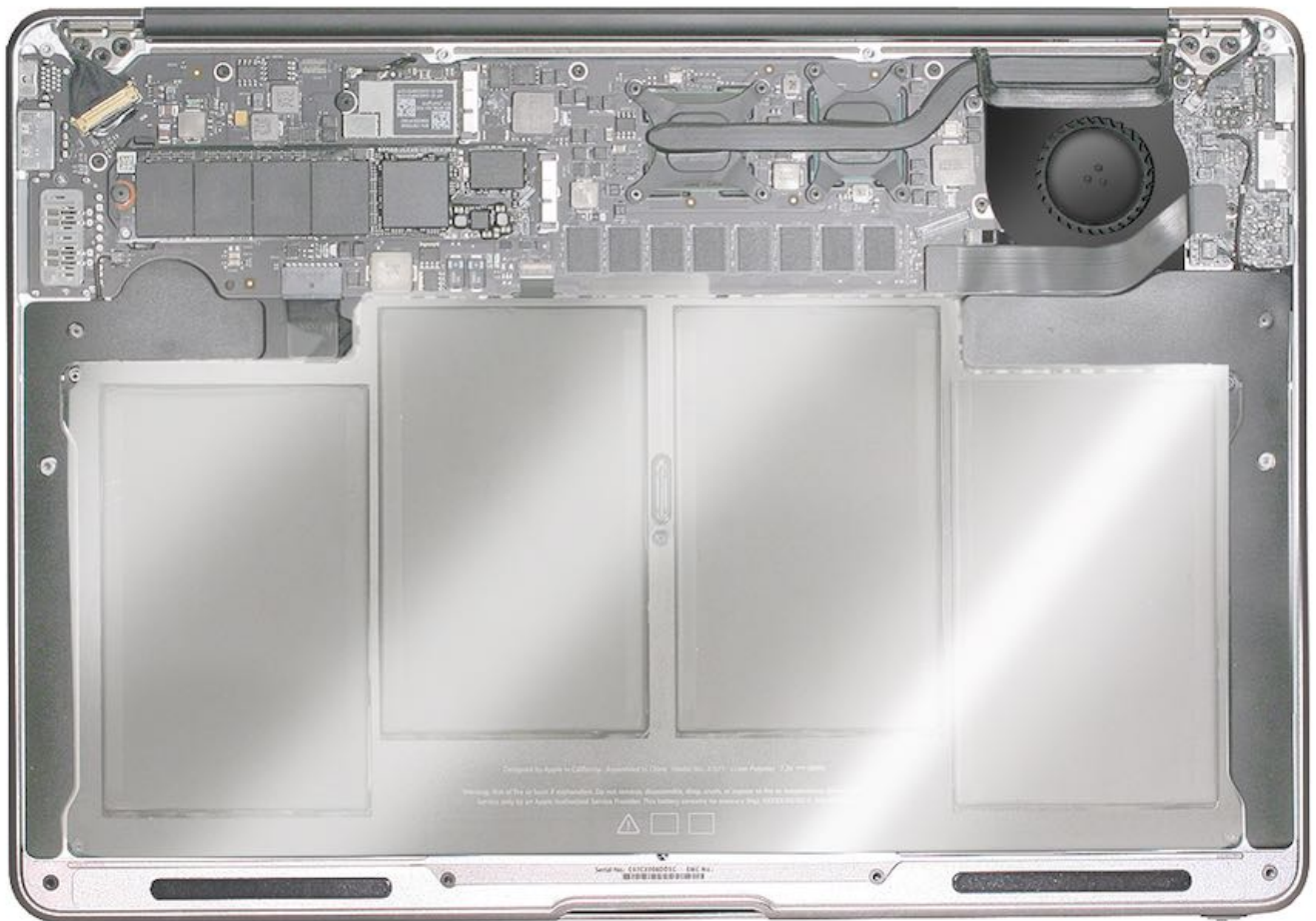
Remove:

- [Bottom Case](#)
- [I/O Flex Cable](#)



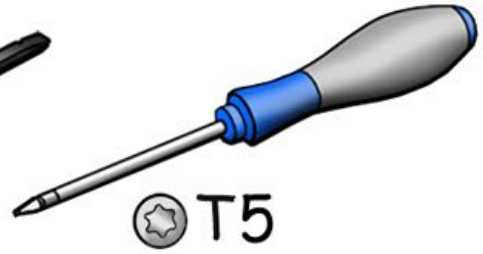
Important: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board.

Caution: Read [Battery Safety Precautions](#) before performing this procedure.



Tools

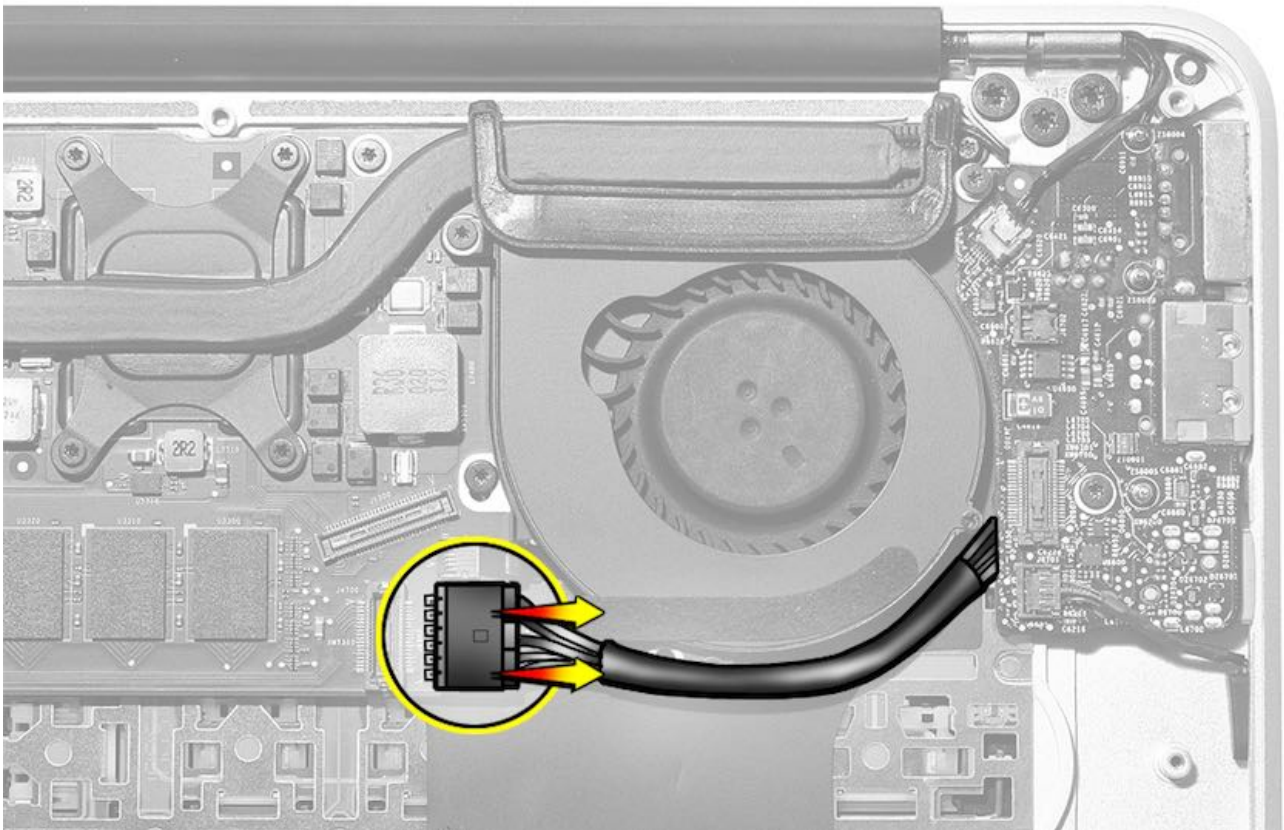
- ESD wrist strap
- Black stick
- Torx T5 screwdriver, magnetized



Steps For Removal

1. Disconnect I/O board cable from logic board.

Replacement Note: If the I/O board was removed, install it prior to replacing the fan.



2. Remove three Torx #5 screws.

Note: Each screw is a different size.

- T5: 922-9660, 2.7 mm, short, top left

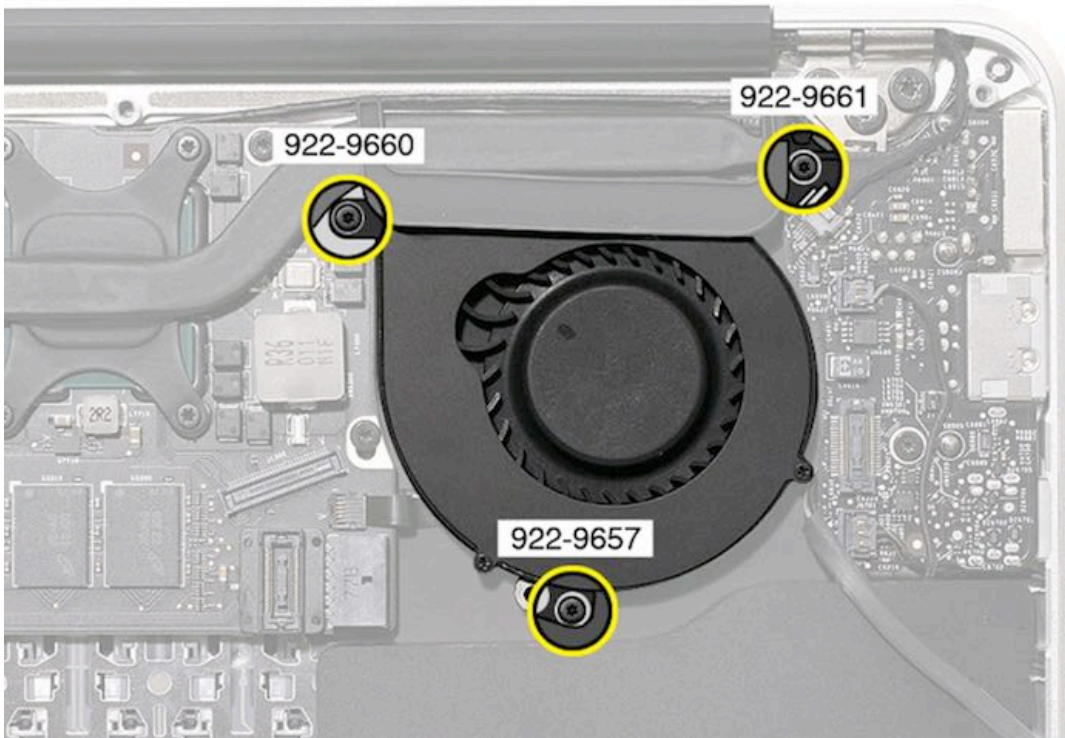


- T5: 922-9661, 3.6 mm, long, top right



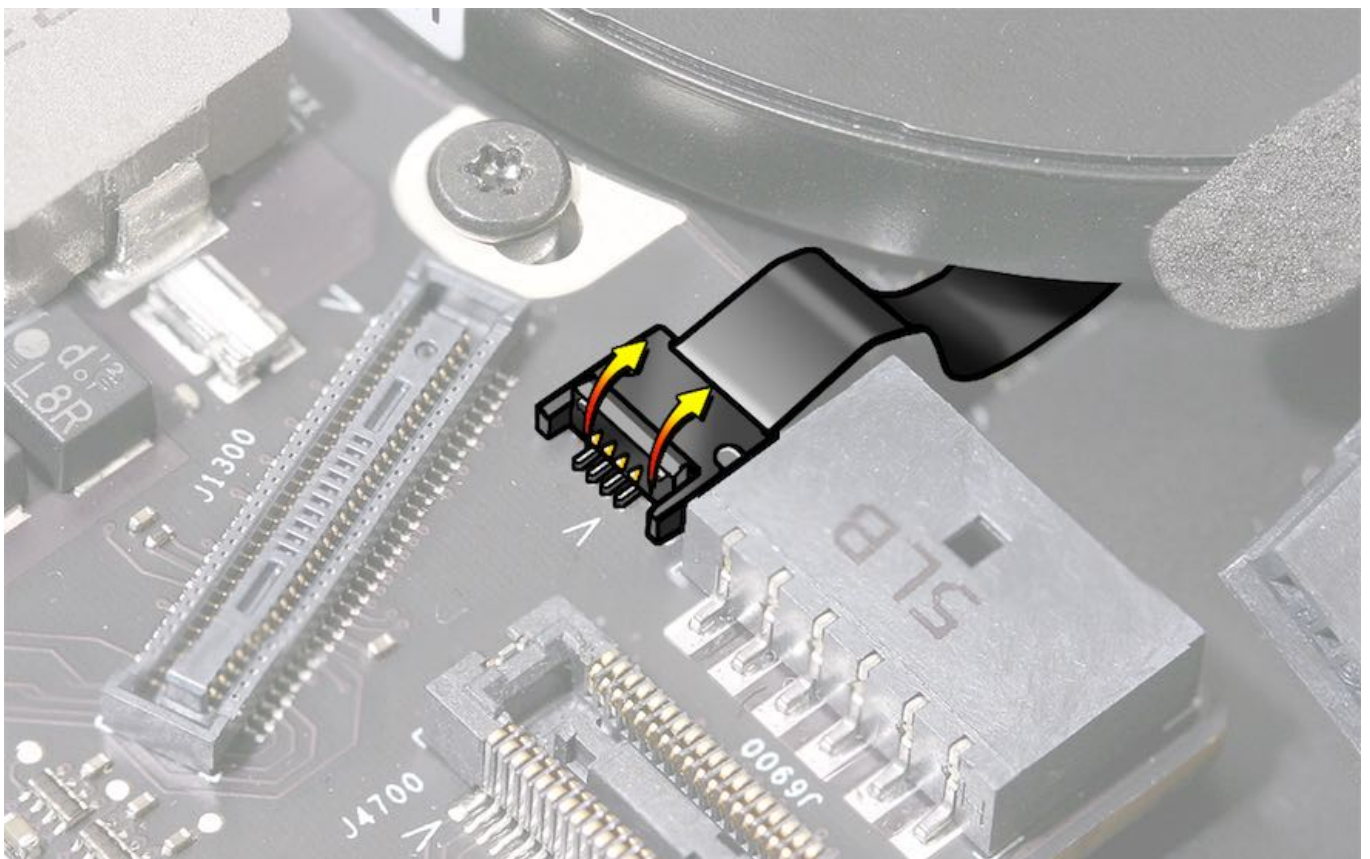
- T5: 922-9657, 3.6 mm, medium, bottom



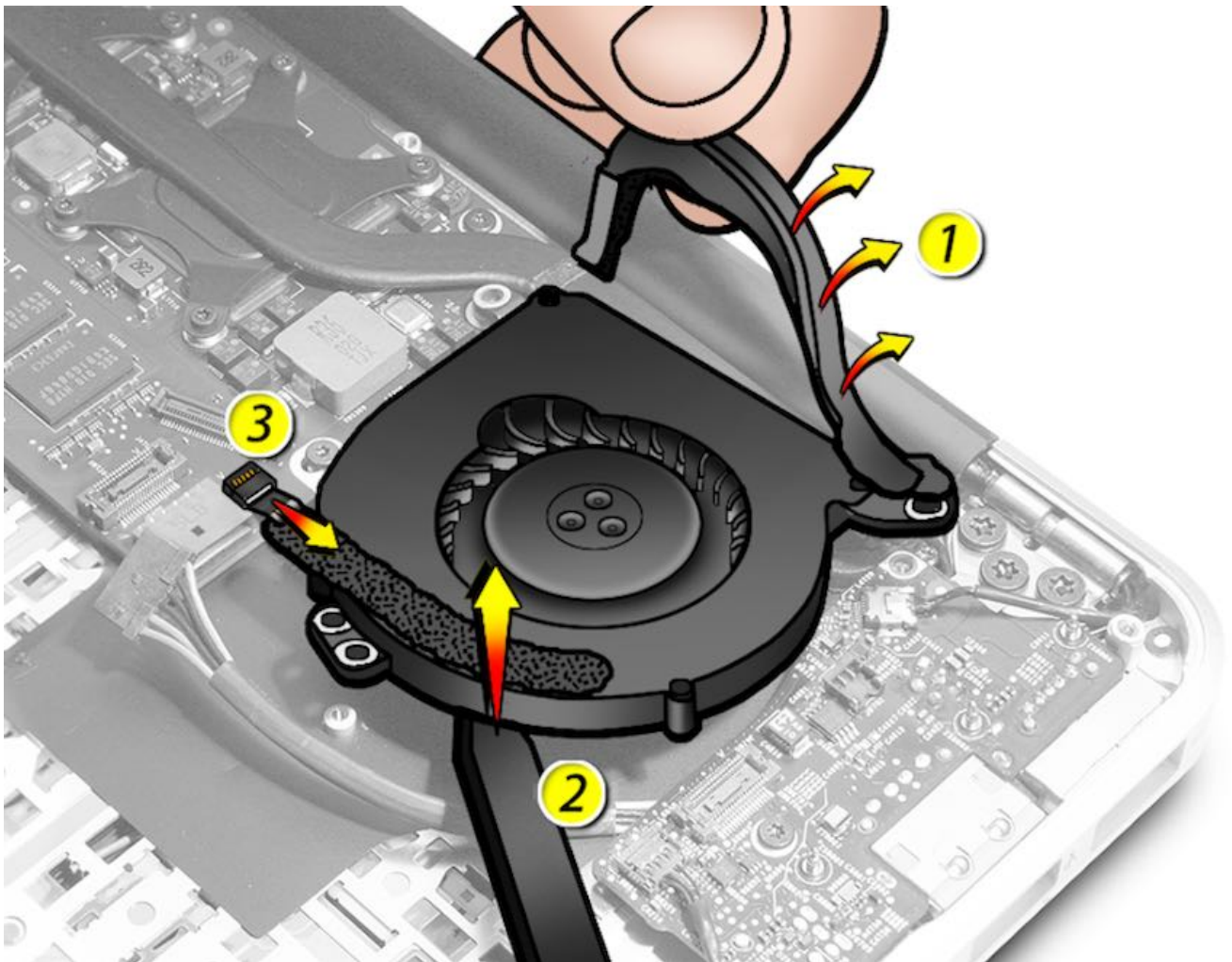


3. On the logic board, lift locking lever and carefully disconnect flexible fan cable.

Replacement Note: Insert cable before titling fan into top case. Check that locking lever is flipped down to secure flexible cable.



4. Lift thermal gasket (1), pry fan up (2), and gently pull flexible fan cable out of connector (3).



Steps For Reassembly

1. Insert tiny fan flex cable into connector and close locking lever.
2. Install fan in top case and install three T5 fan screws.
3. Check that rubber gasket is flat and adheres to top of fan.

Input/Output (I/O) Board

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to article [SV156: I/O Board Replacement Video](#).

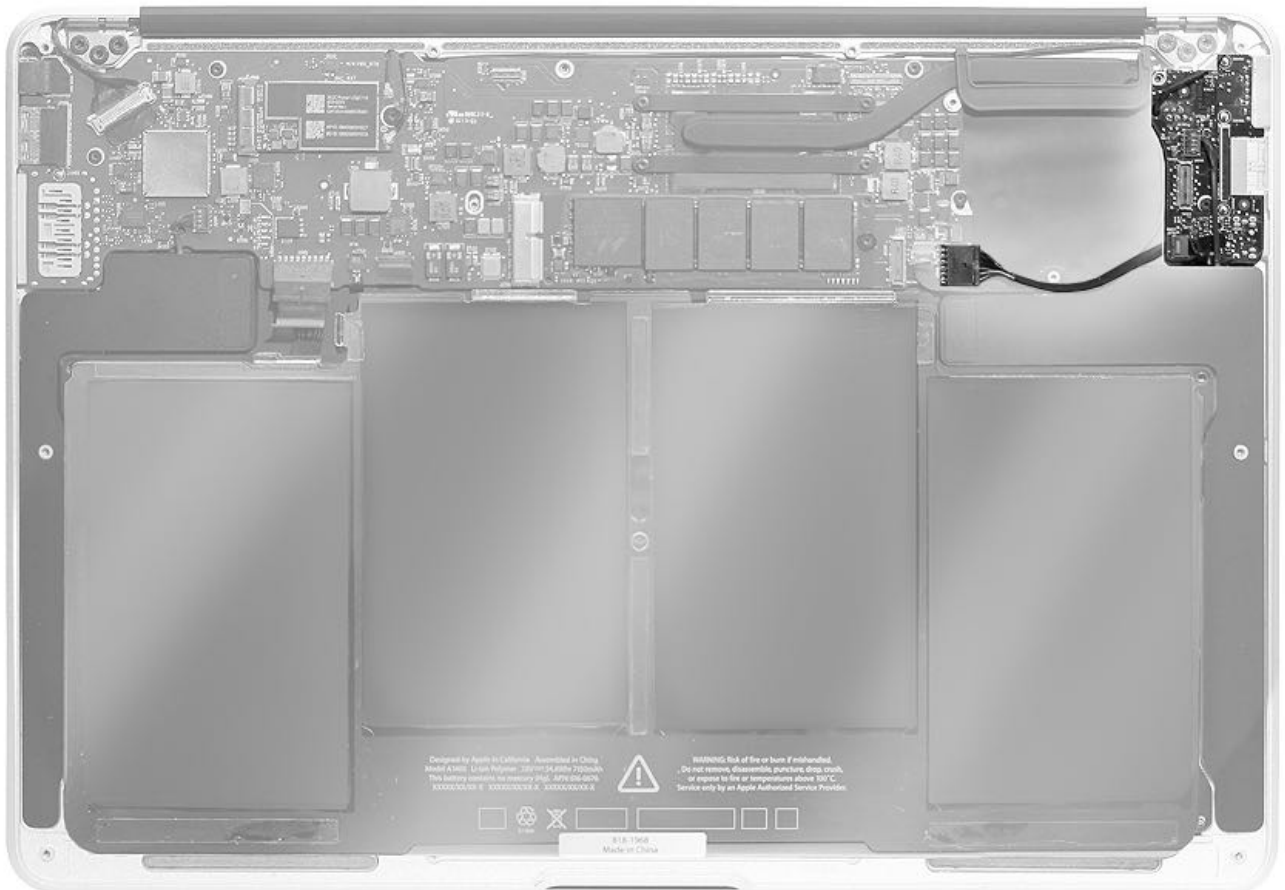
Remove:

- [Bottom Case](#)
- [I/O Flex Cable](#)
- [Fan](#)



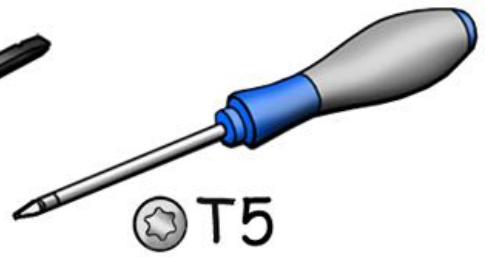
Important: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board.

Caution: Read [Battery Safety Precautions](#) before performing this procedure.



Tools

- ESD wrist strap
- Black stick
- Torx T5 screwdriver, magnetized



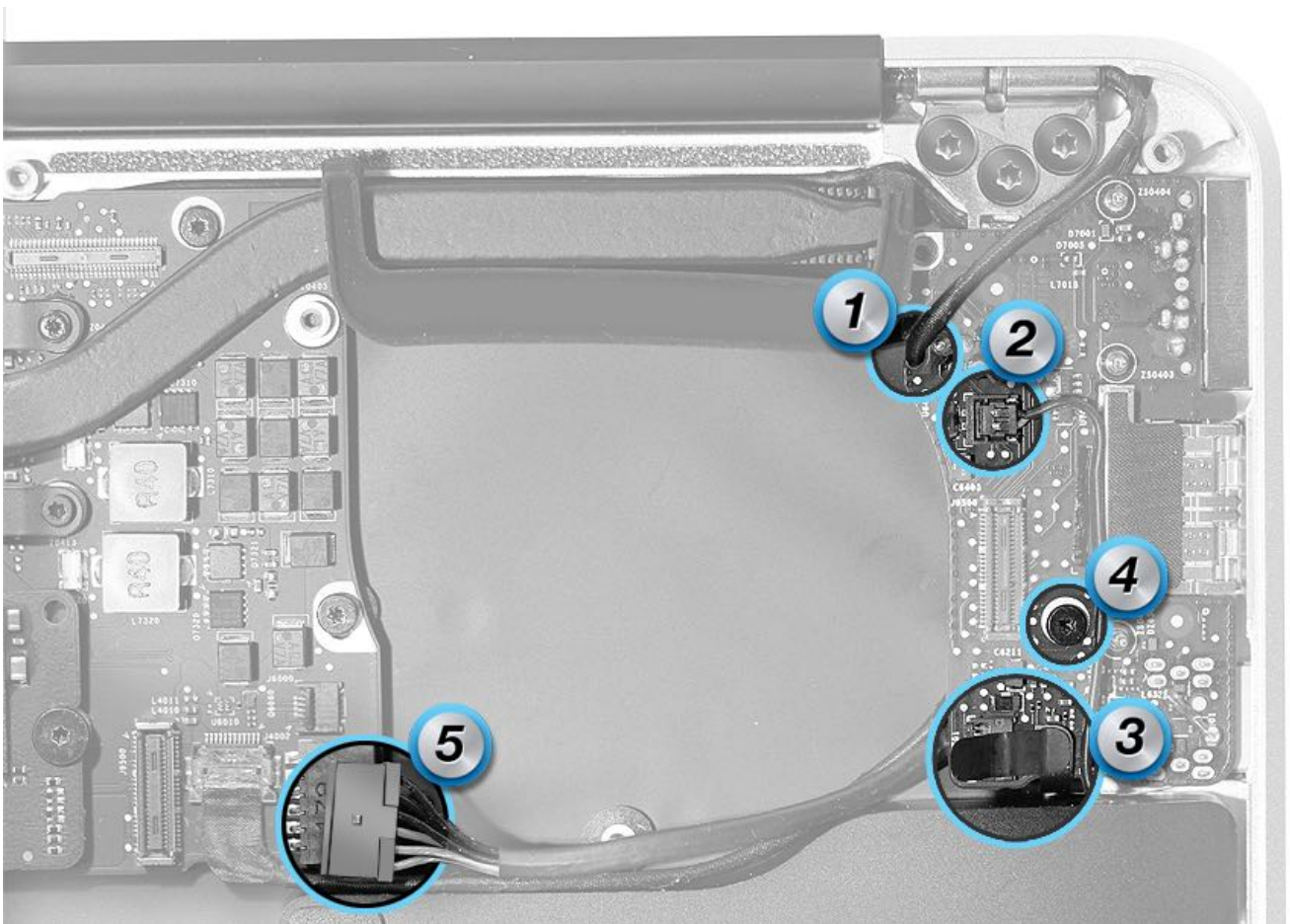
T5

Steps For Removal

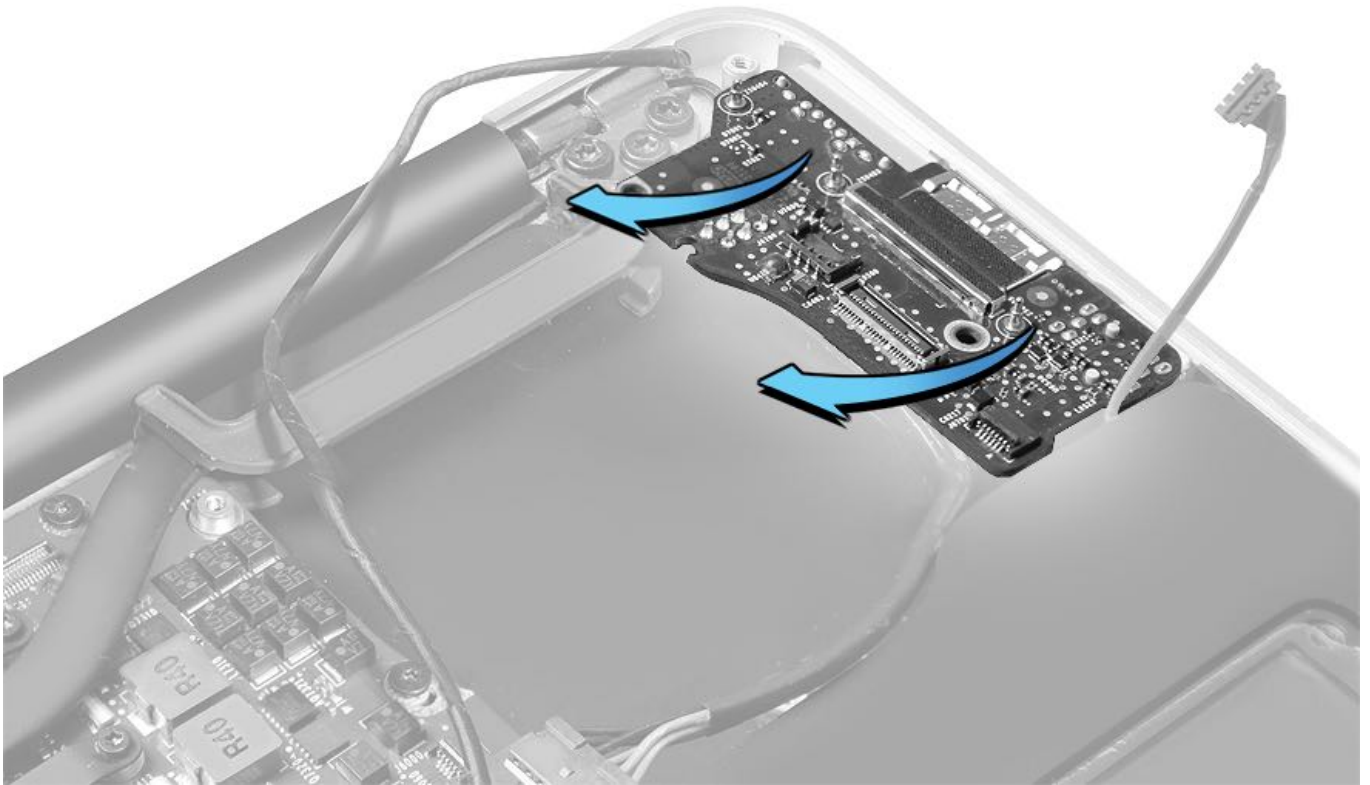
1. Remove camera cable (#1) from notch in I/O board.
2. Disconnect left speaker cable (#2).
3. Lift pull tab (#3) to reveal the microphone cable connector. Use a black stick to flip up the locking lever on the connector to disconnect the microphone cable from the I/O board.
4. Remove one Torx T5 screw (#4).



5. If you have not already done so, disconnect I/O board cable (#5) from logic board.

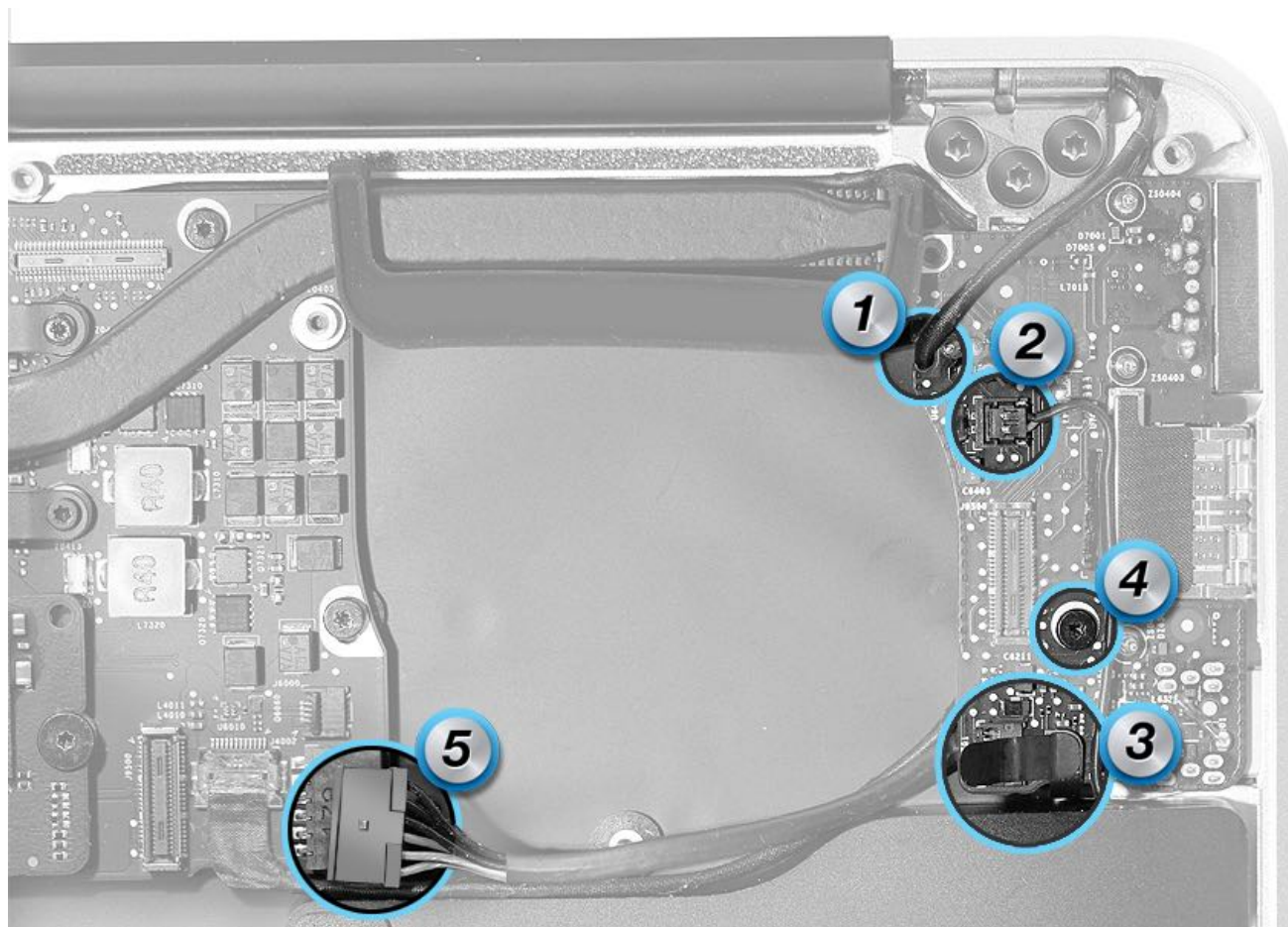


6. Tilt I/O board slightly and move board away from ports and out of top case.



Steps For Reassembly

1. Tip I/O board into top case and slide it firmly against top case wall to secure ports.
2. Check that the camera cable (#1) is routed as shown.
3. Replace one Torx T5 screw (#4).
4. Reconnect left speaker (#2) and microphone (#3) cables.
5. Reconnect I/O board cable (#5) to the logic board.



Input Device (IPD) Flex Cable

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to article [SV165: IPD Flex Replacement Video](#) (Mid 2012 to 2017).

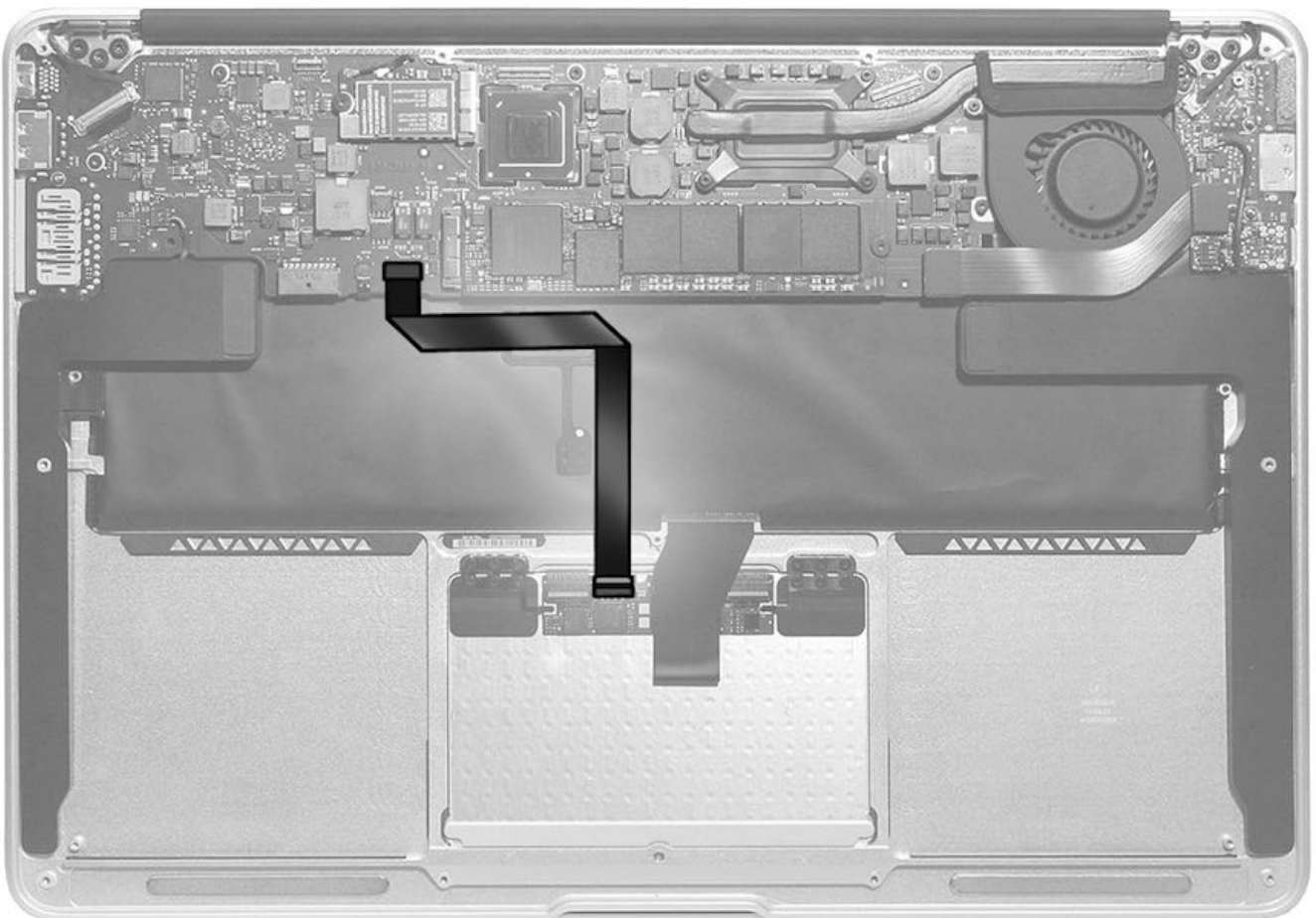
Remove:

- [Bottom Case](#)
- [Battery](#)



Important: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board.

Caution: Read [Battery Safety Precautions](#) before performing this procedure.



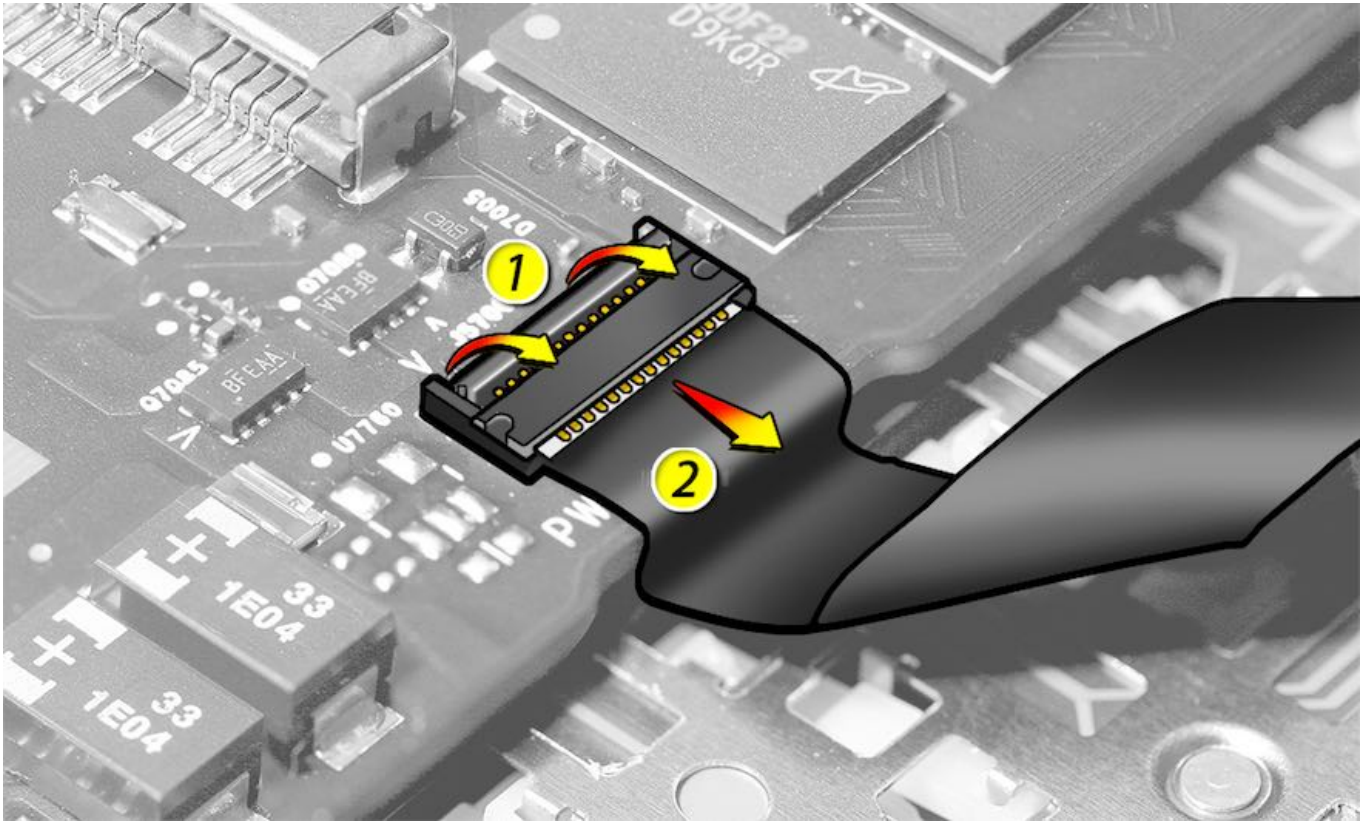
Tools

- ESD wrist strap
- Black stick

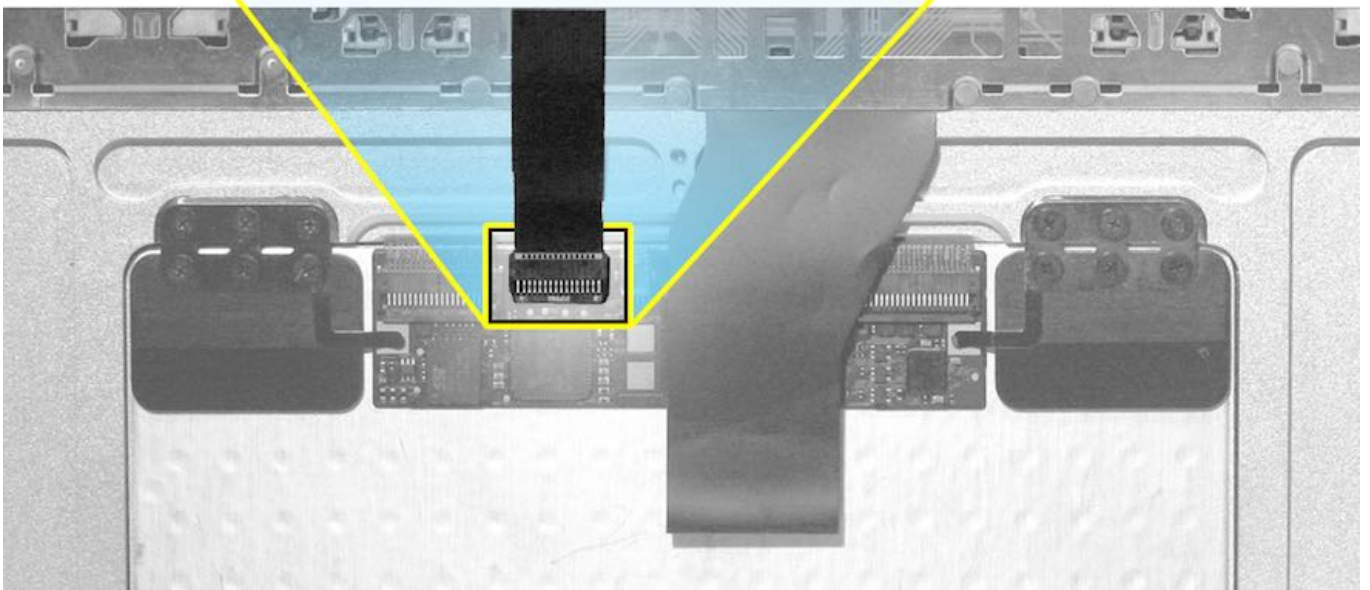
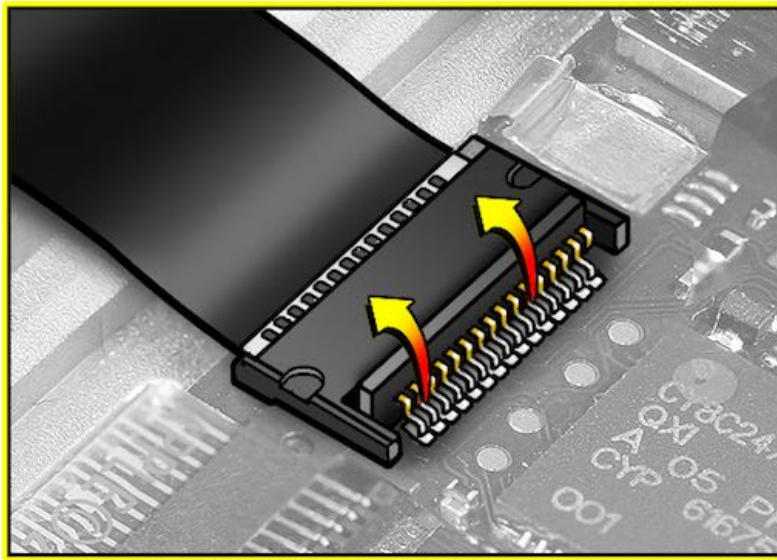


Steps For Removal

1. Disconnect cable from locking lever connector at logic board.



2. Disconnect cable from locking lever connector at trackpad.



Steps For Reassembly

Reassemble in reverse order of removal steps.

Replacement Note: When installing a new cable, peel off adhesive backing on the back of the cable. Press gently to adhere the cable to the top case.

Heat Sink and Heat Sink Gasket

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to article [SV157: Heat Sink Replacement Video](#).

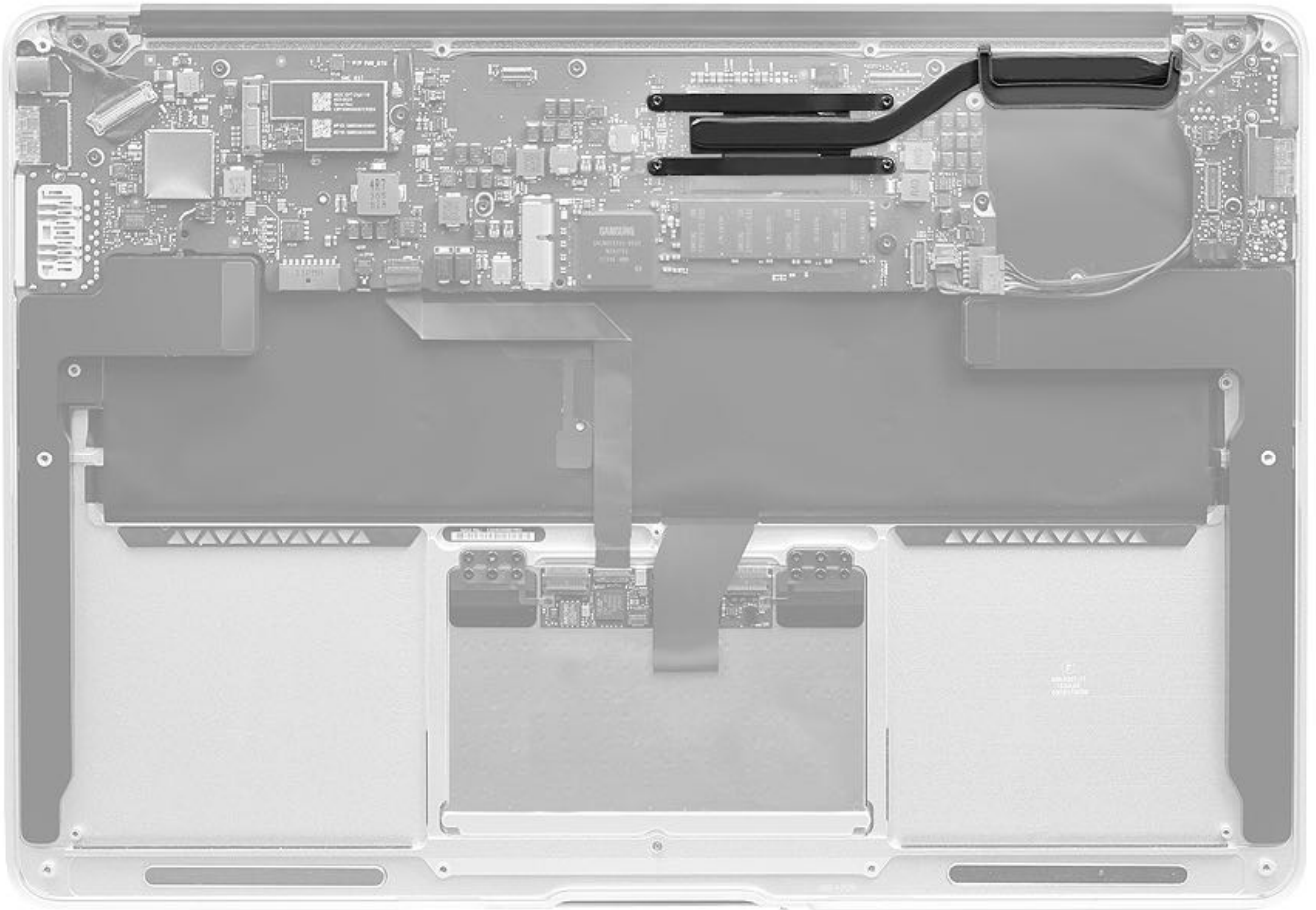
Remove:

- [Bottom Case](#)
- [Battery](#)
- [I/O Flex Cable](#)
- [Fan](#)



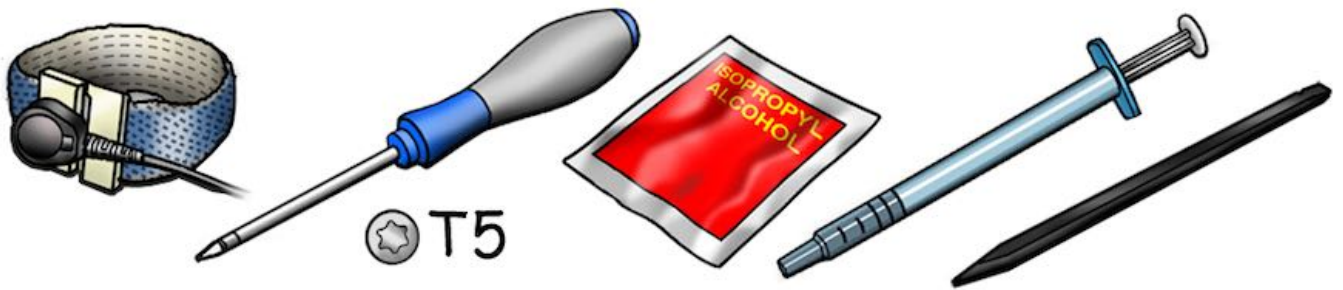
Important: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board.

Caution: Read [Battery Safety Precautions](#) before performing this procedure.



Tools

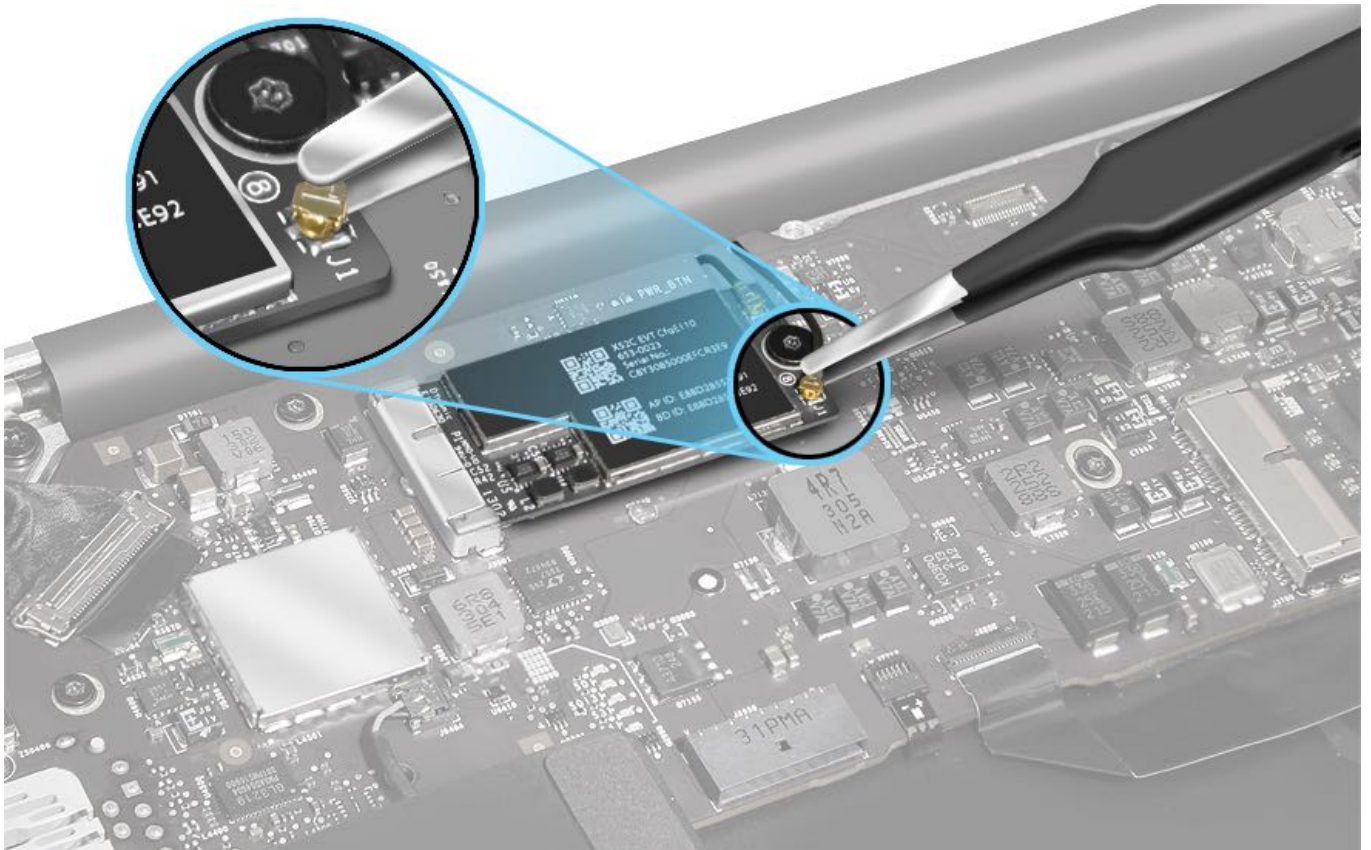
- ESD wrist strap
- Torx T5 screwdriver, magnetized
- Alcohol pads
- Thermal grease syringe (922-7144)
- Black stick



Steps For Removal

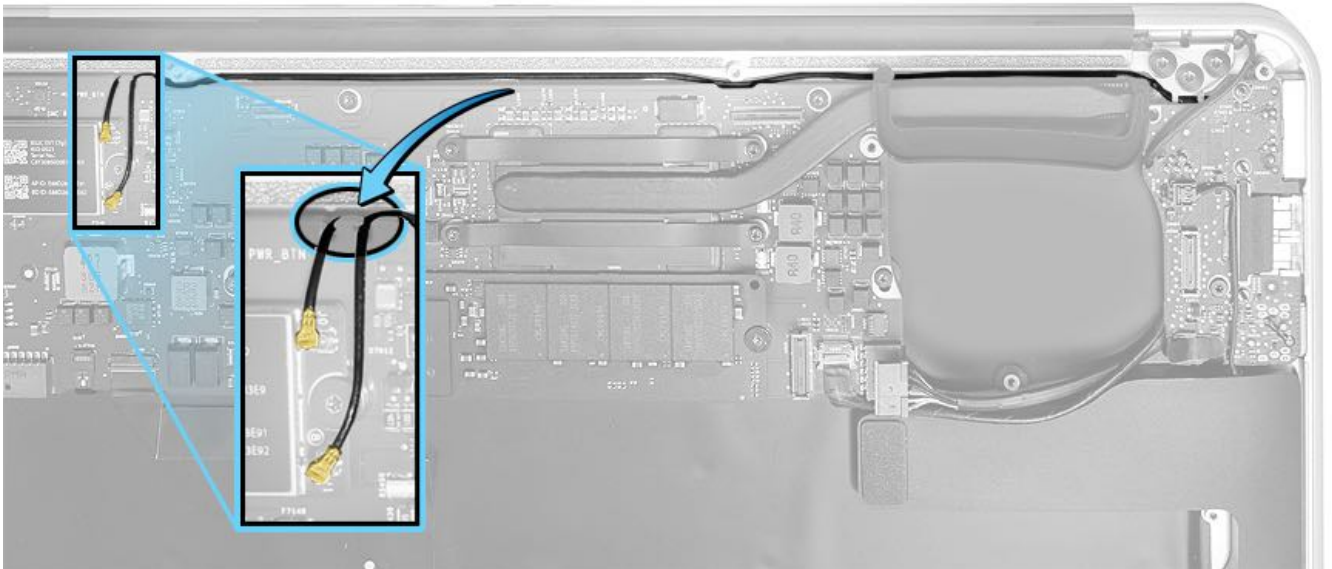
Important: The wireless card antenna cable routes very close to mounting screw for heat sink arm. To avoid damaging this cable when removing or replacing screw, perform the following three steps to move antenna cable out of the way.

1. Disconnect antennas from wireless card.



2. Remove antennas from notches in logic board and from channel along top of logic board.

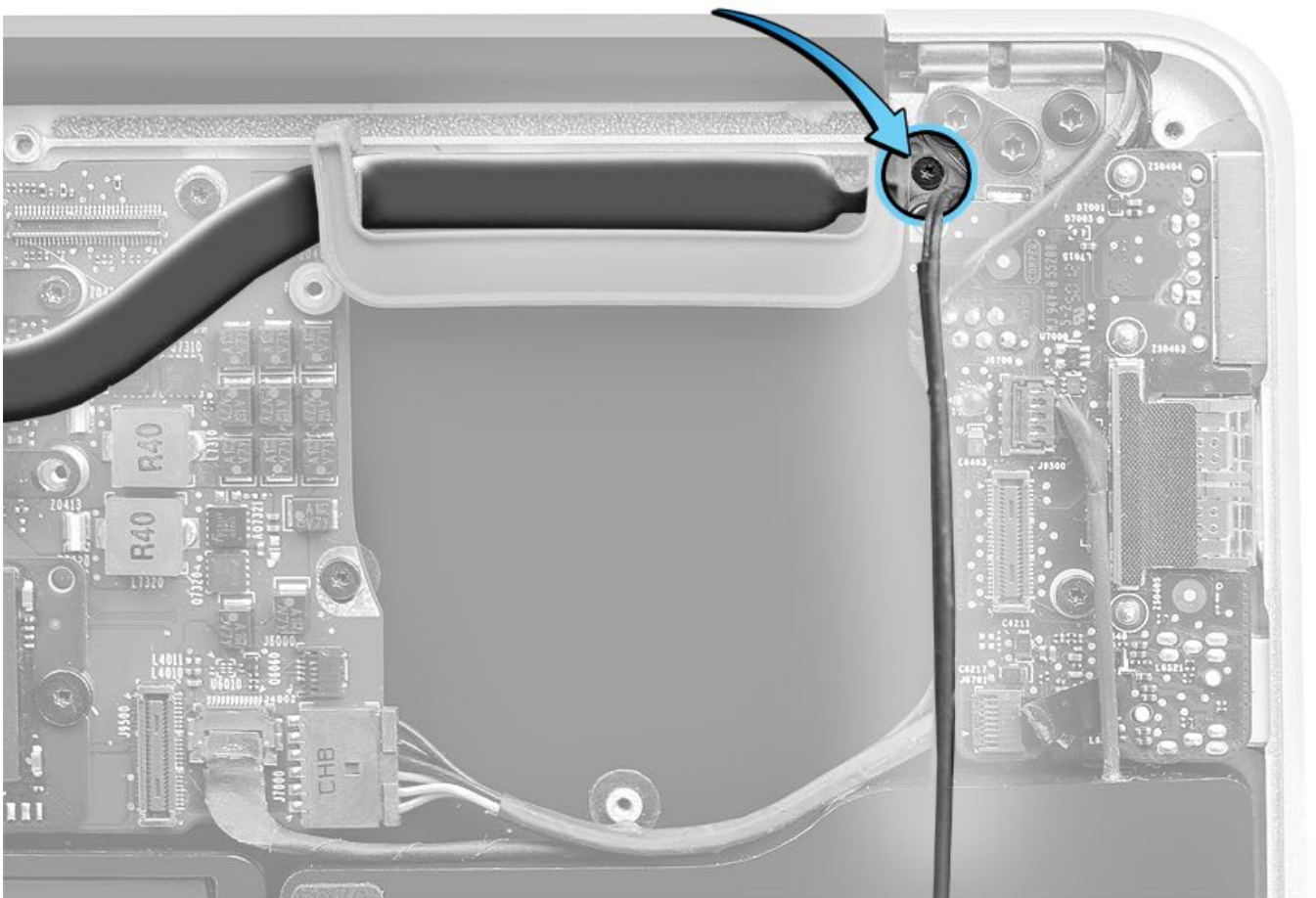
Note: Antenna cable routes under heat sink gasket.



3. Move antenna cable away from heat sink screw.

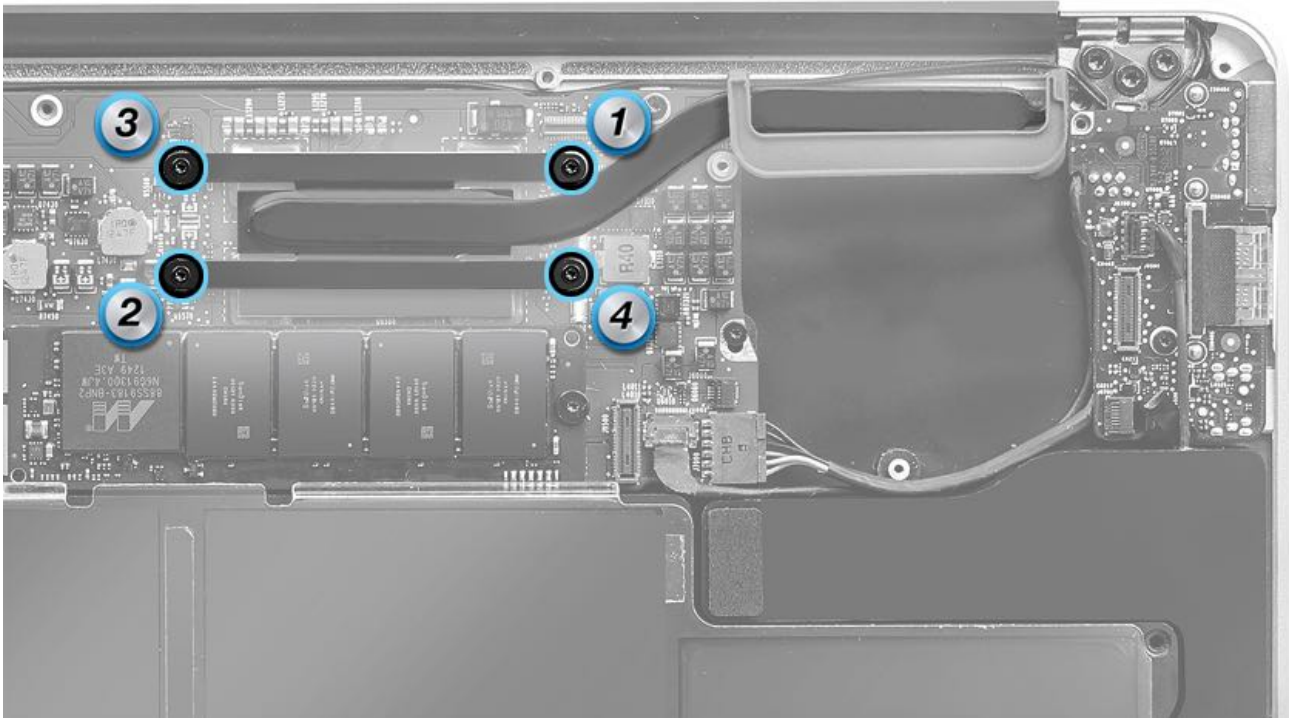
4. Remove one Torx T5 screw securing heat sink arm:

- T5: 922-9655, 2.4 mm



5. Remove four Torx T5 heat sink screws:

- T5: 922-9653, 1.8 mm

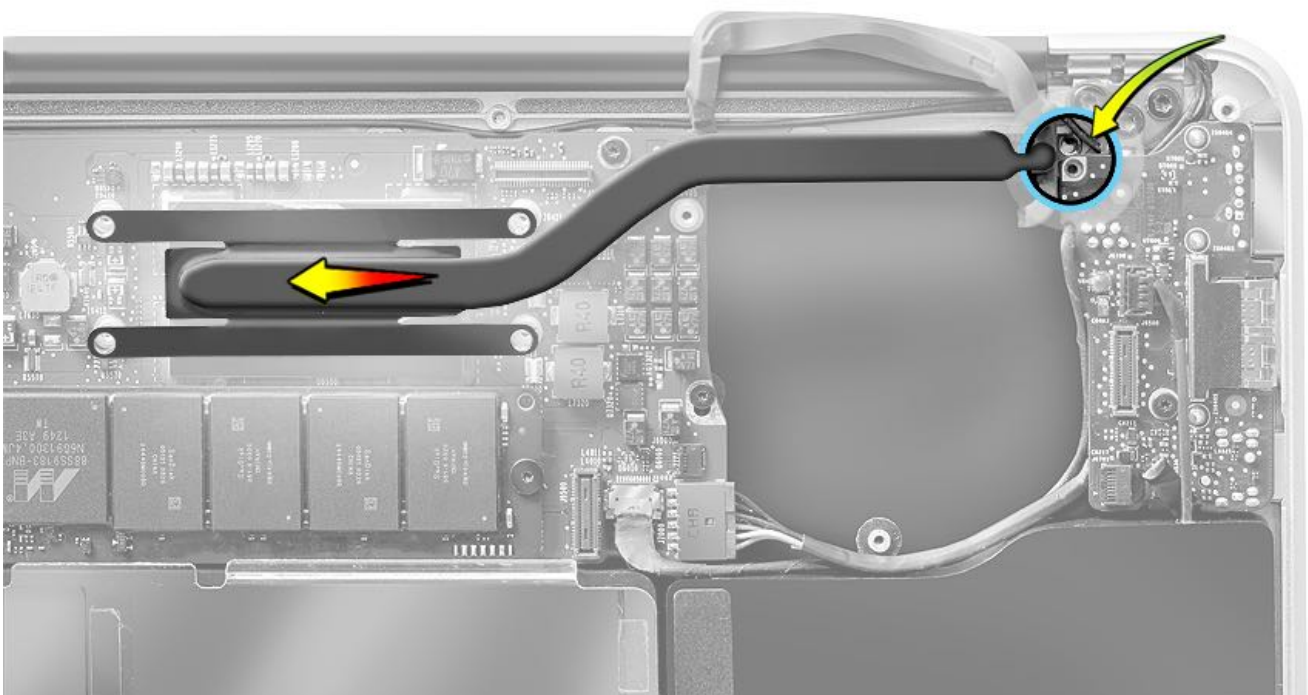


6. Carefully lift heat sink gasket off heat sink, rotate back, and rest it against display clutch cover.

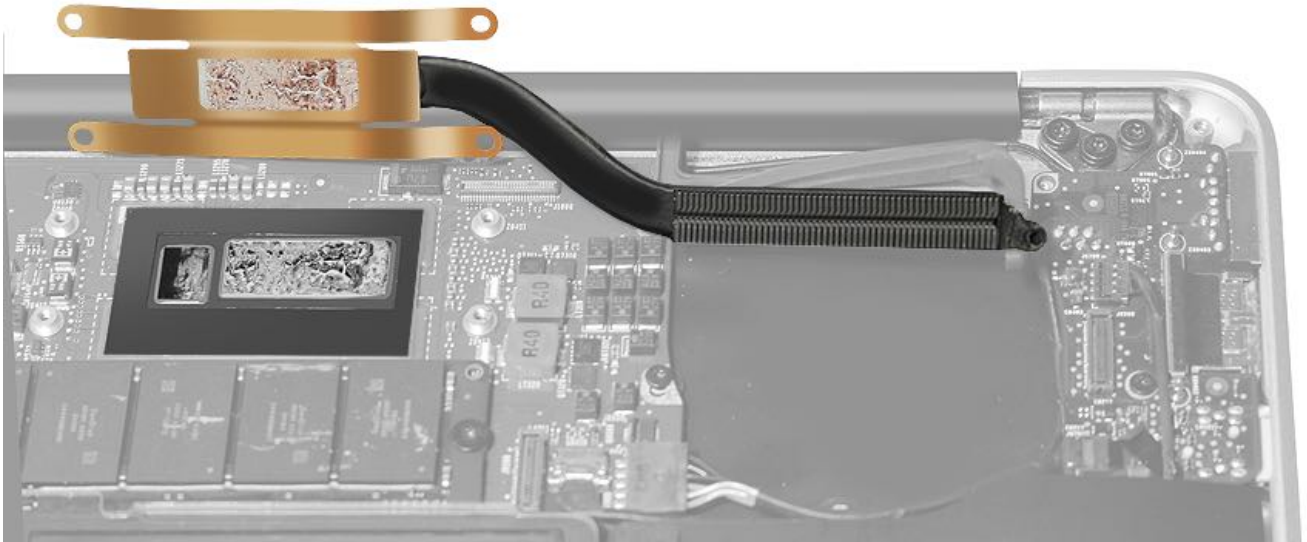
7. Keeping heat sink parallel to logic board, gently wiggle it to loosen bond and then shift heat sink slightly to the left to clear arm from top case.



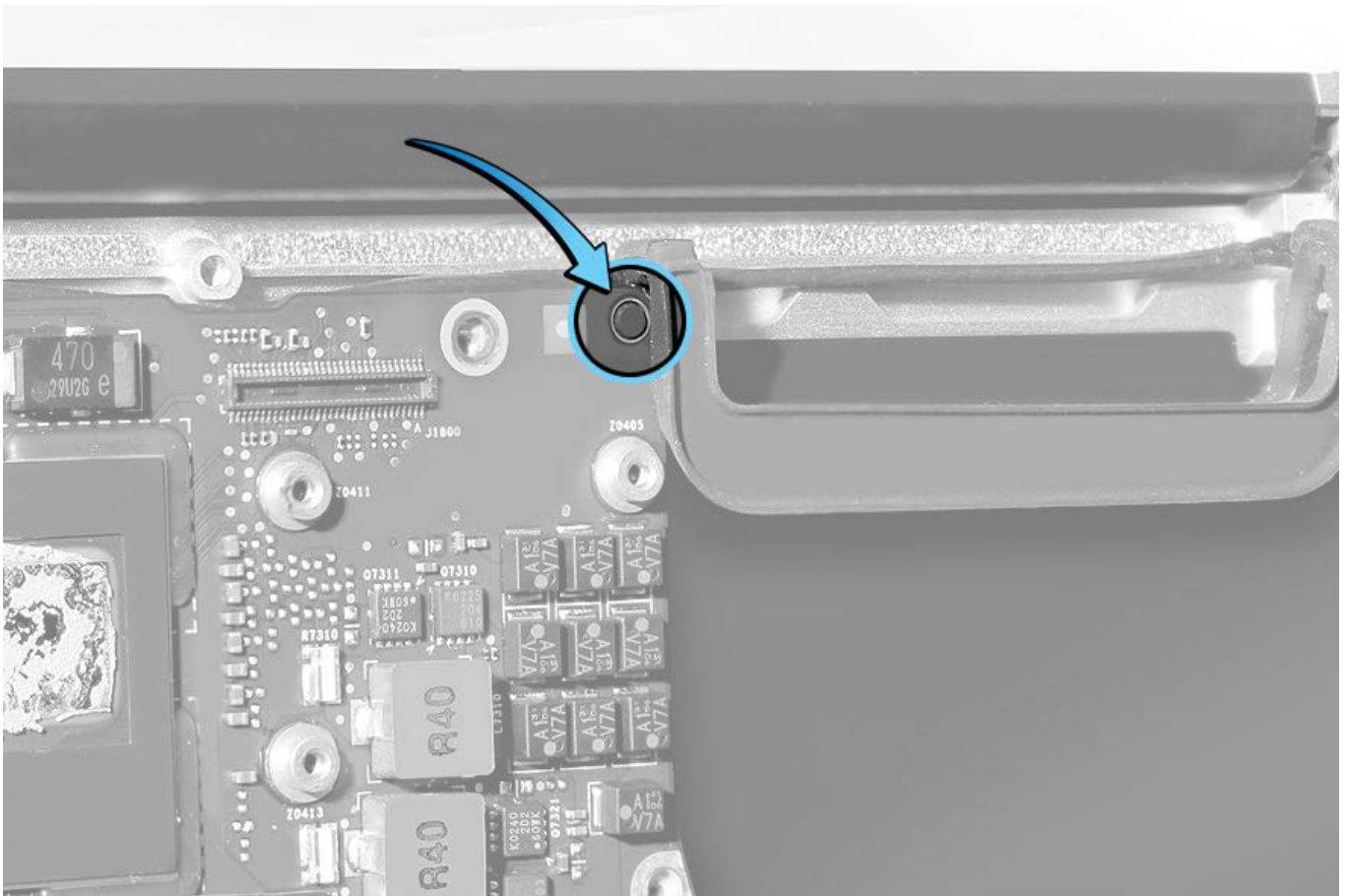
Caution: Always hold heat sink by the body, not by the heat sink arm.



8. Rotate heat sink and gasket away from logic board.

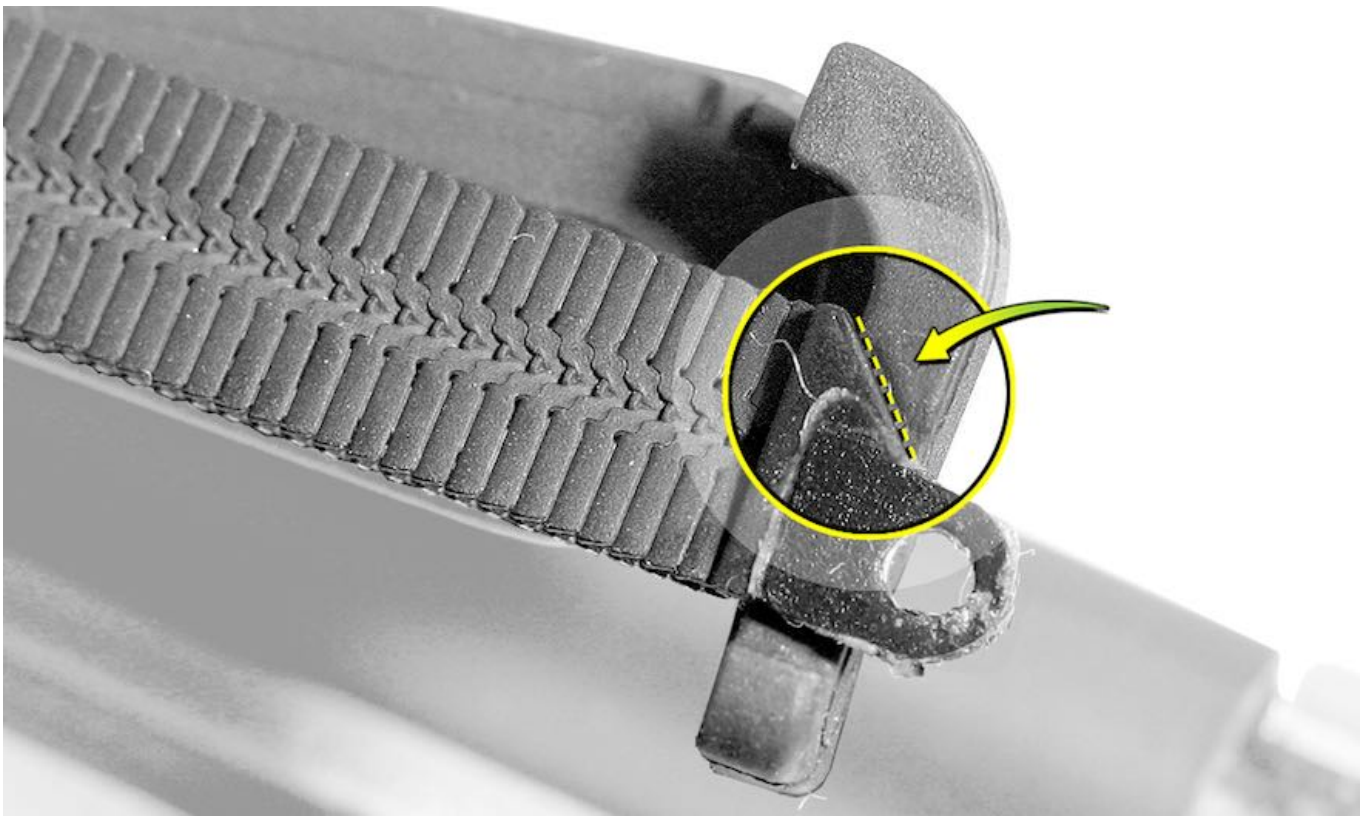


Replacement Note: The heat sink gasket (922-9669) wraps around the logic board. The small rubber nub (circled) on the gasket should be pushed into the hole on the logic board. When you remove heat sink from logic board, the gasket should stay with logic board. If you need to replace the heat sink gasket with new gasket, you must first remove the logic board. Refer to [Logic Board](#) procedure.

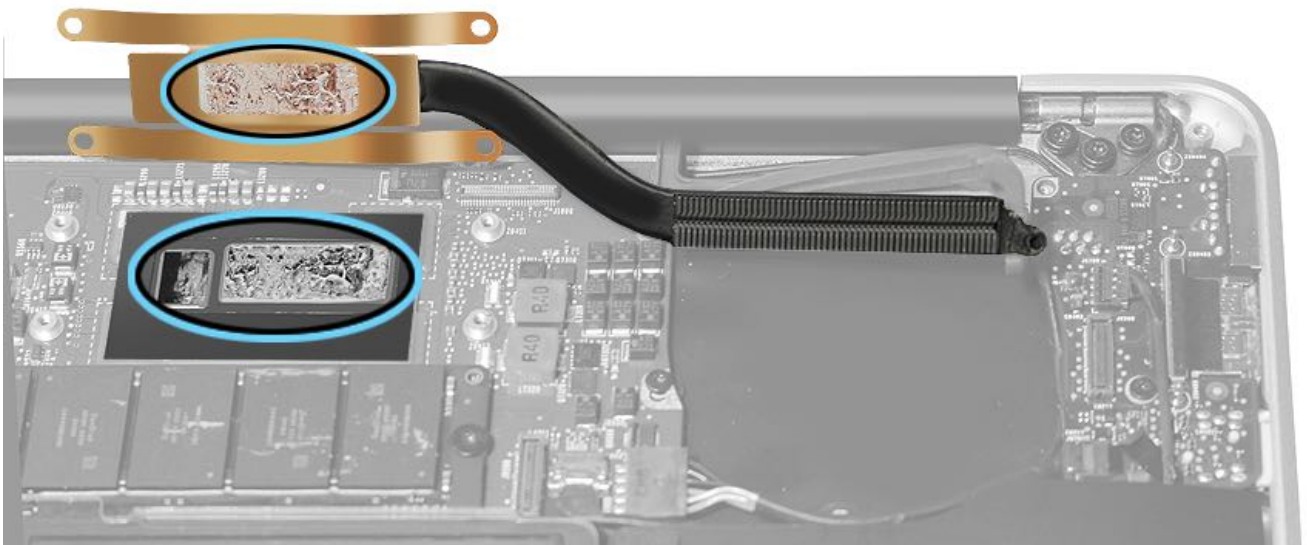


9. Observe how gasket wraps around heat sink arm. Before installing heat sink on replacement logic board, you must wrap gasket in the same way.

10. Carefully free the heat sink from the gasket.



11. Use alcohol wipe to clean thermal grease from thermal pad and chips. Carefully set heat sink aside.

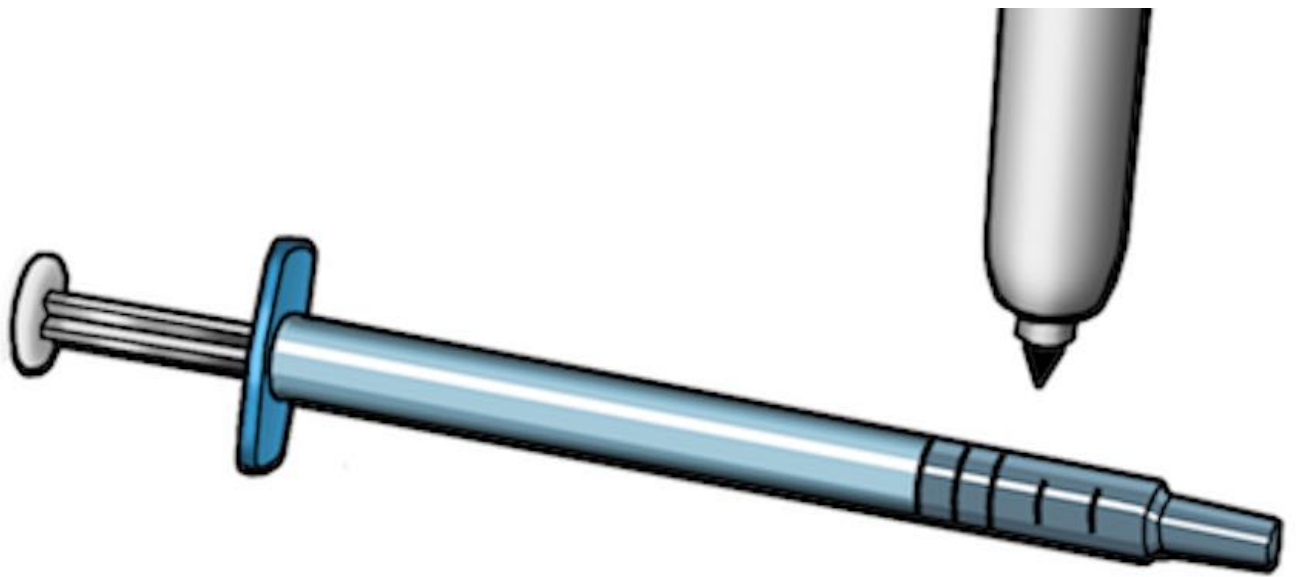


Steps For Reassembly

1. Use a pen to mark the syringe in thirds.

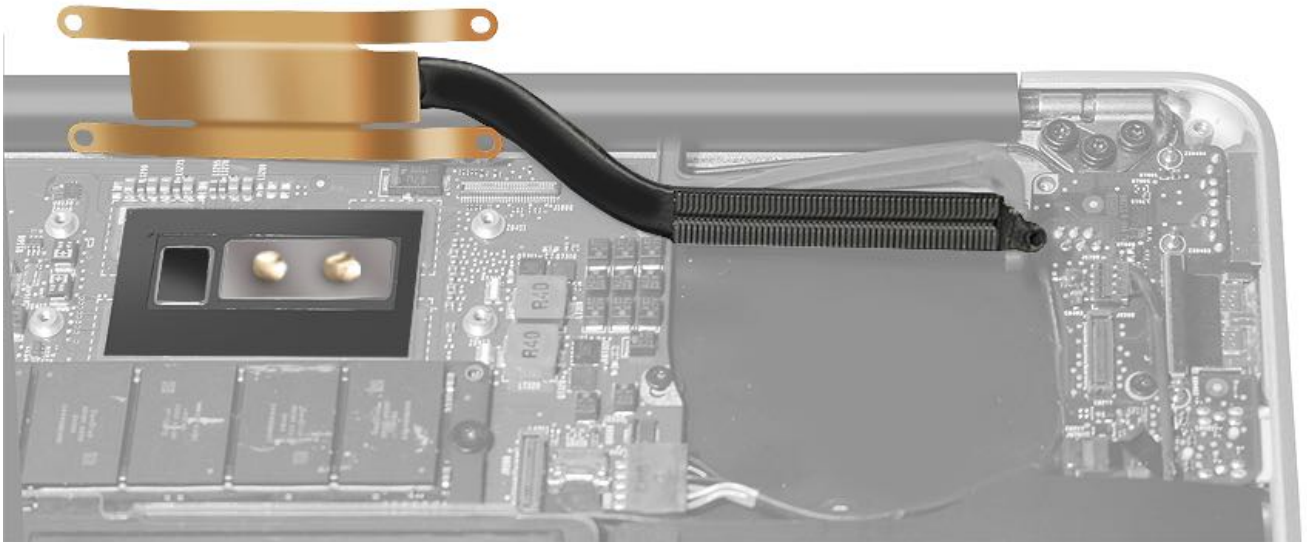


Caution: Syringe (922-7144) contains enough thermal grease for three chips. Because this computer has only one chip, use only $\frac{1}{3}$ of syringe contents.

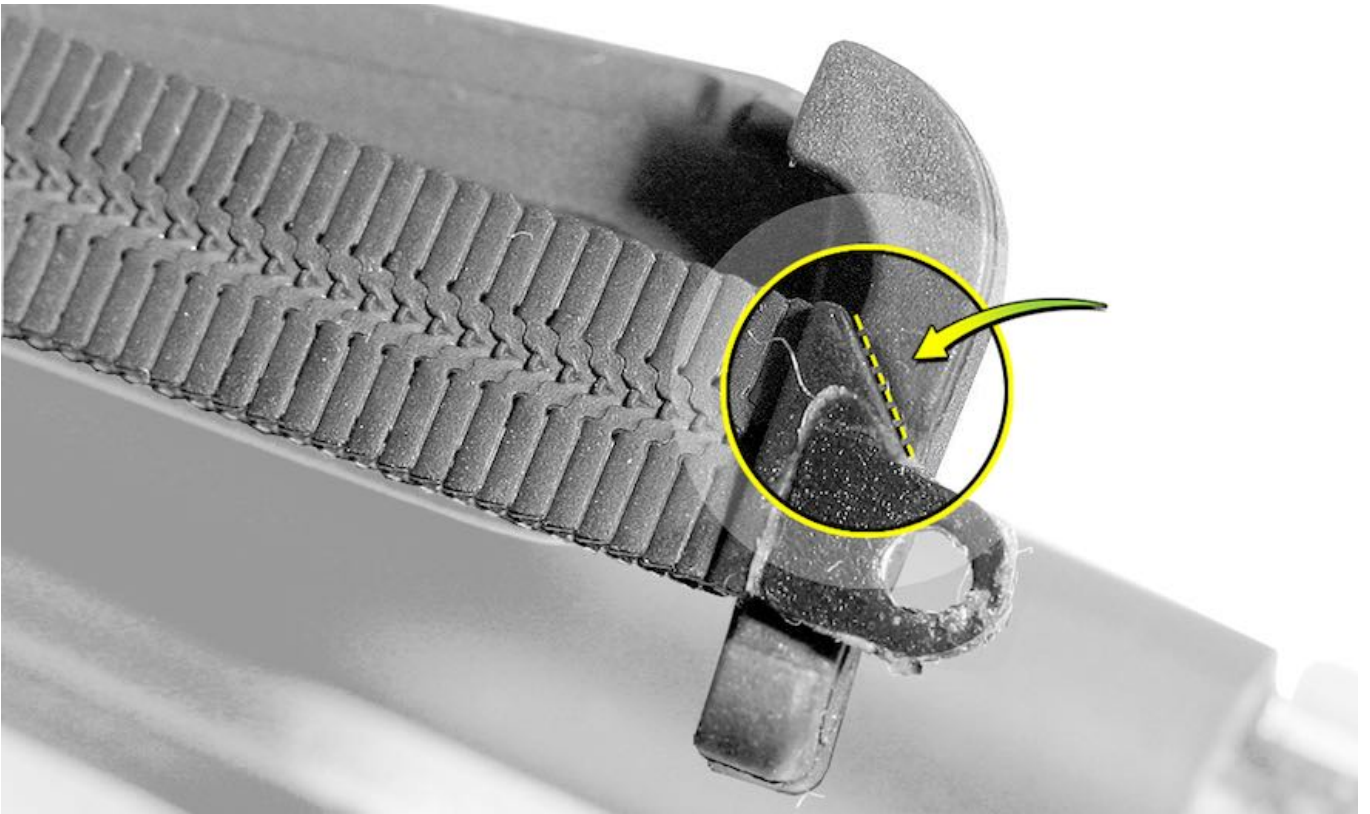


2. Inject $\frac{1}{3}$ of grease placed in a two-dot pattern on large processor chip, as shown.

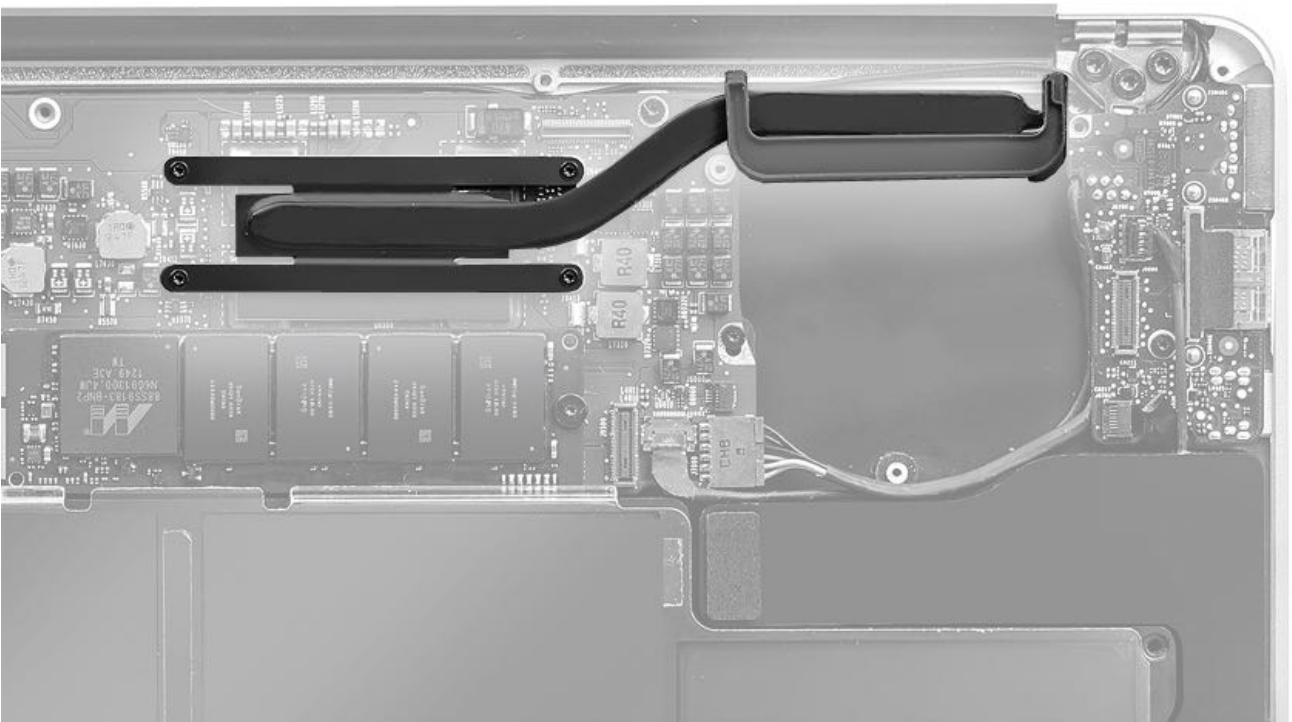
Important: Do not add grease to smaller chip next to it.



3. Wrap heat sink gasket around heat sink. Align edge of heat sink arm with indent on underside of heat sink gasket (shown as dotted line).

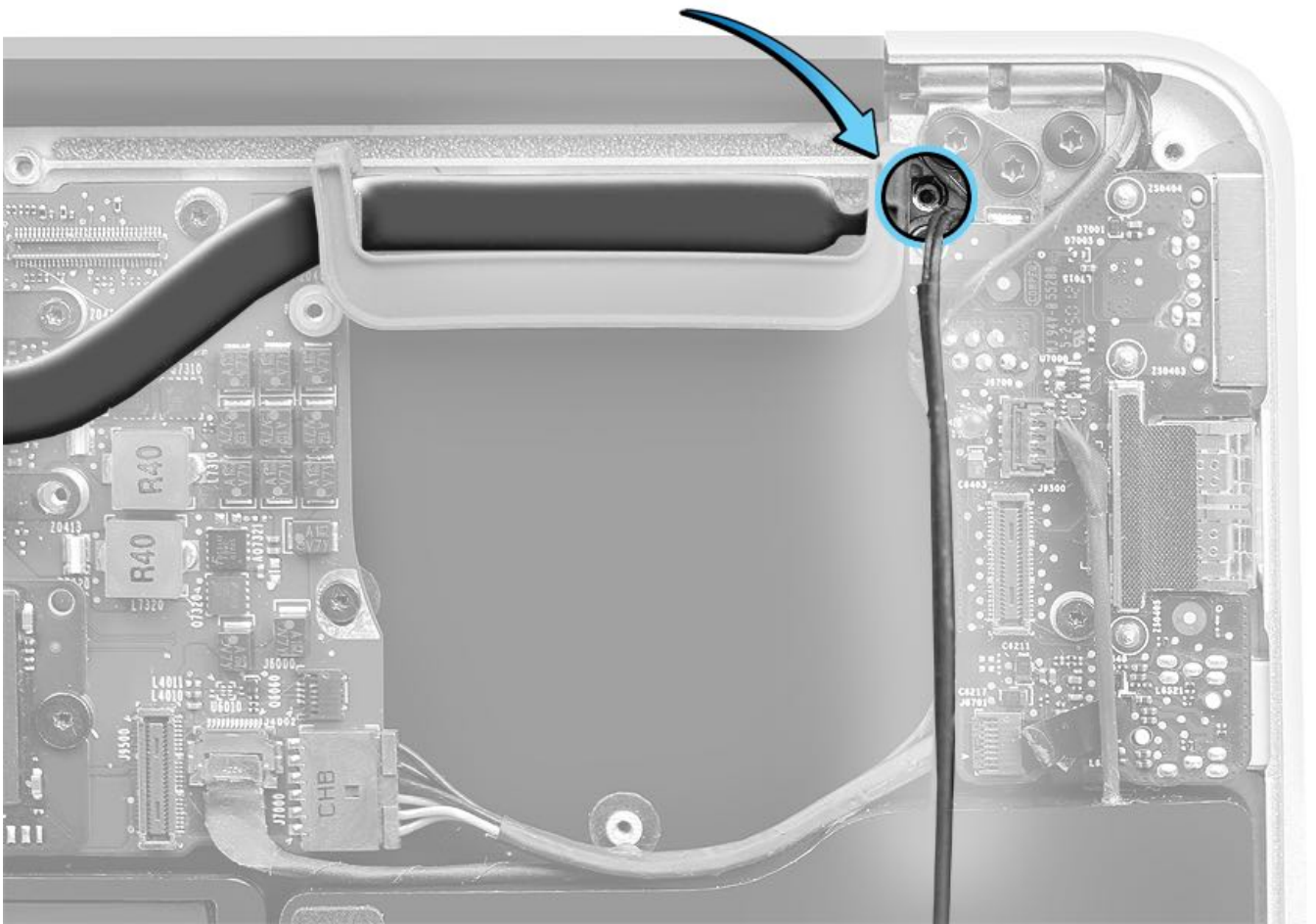


4. Carefully turn over heat sink and gasket and position on logic board, aligning heat sink screw holes with logic board screw holes.

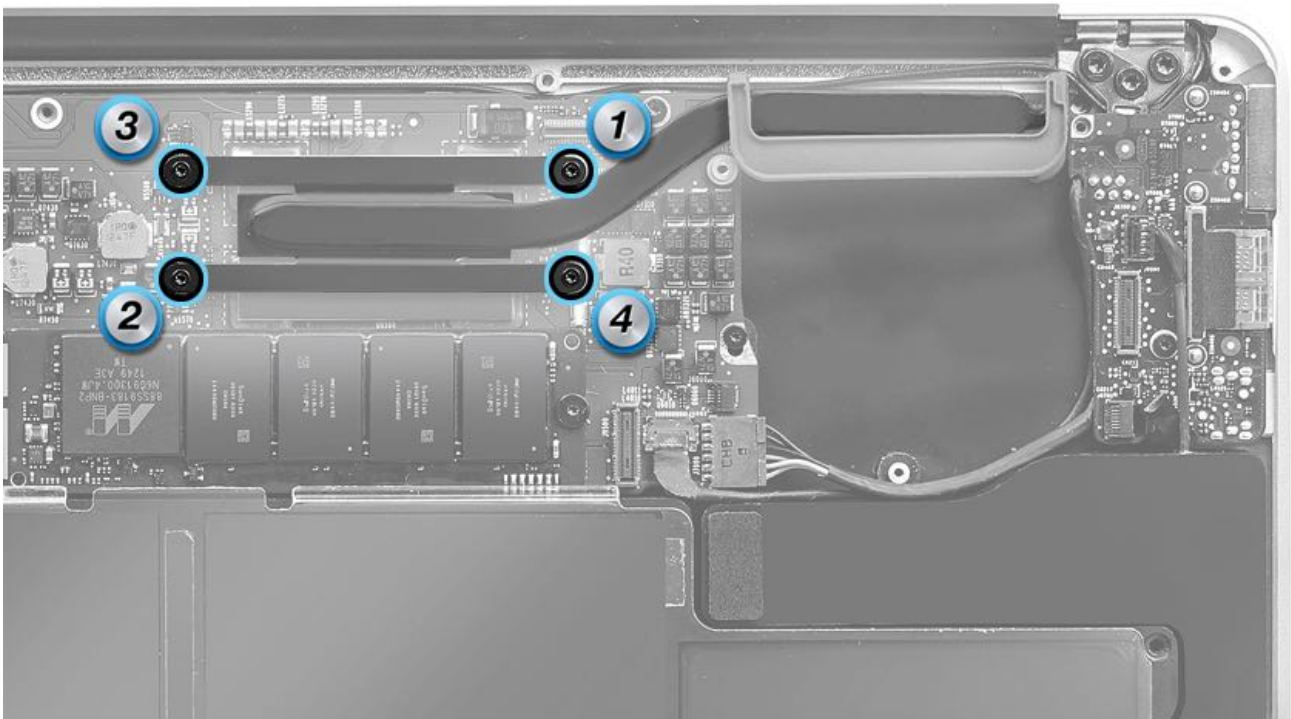


5. Align heat sink arm screw hole with top case standoff. Replace screw.

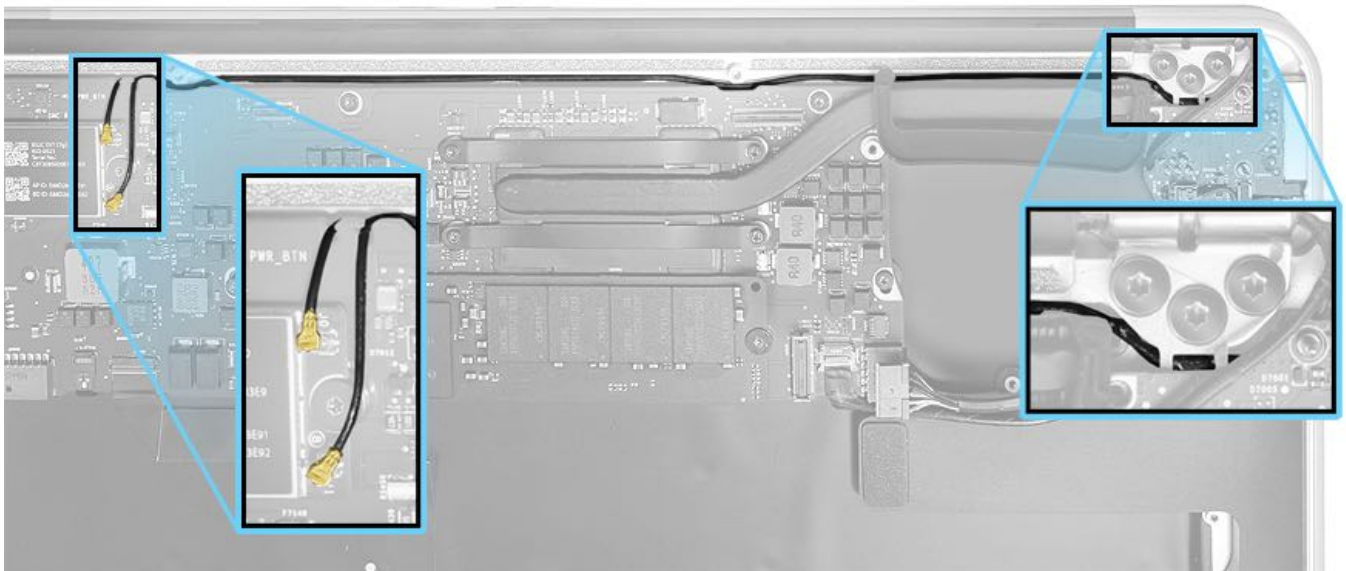
Caution: Be careful not to clip or damage wireless card cable when replacing screw.



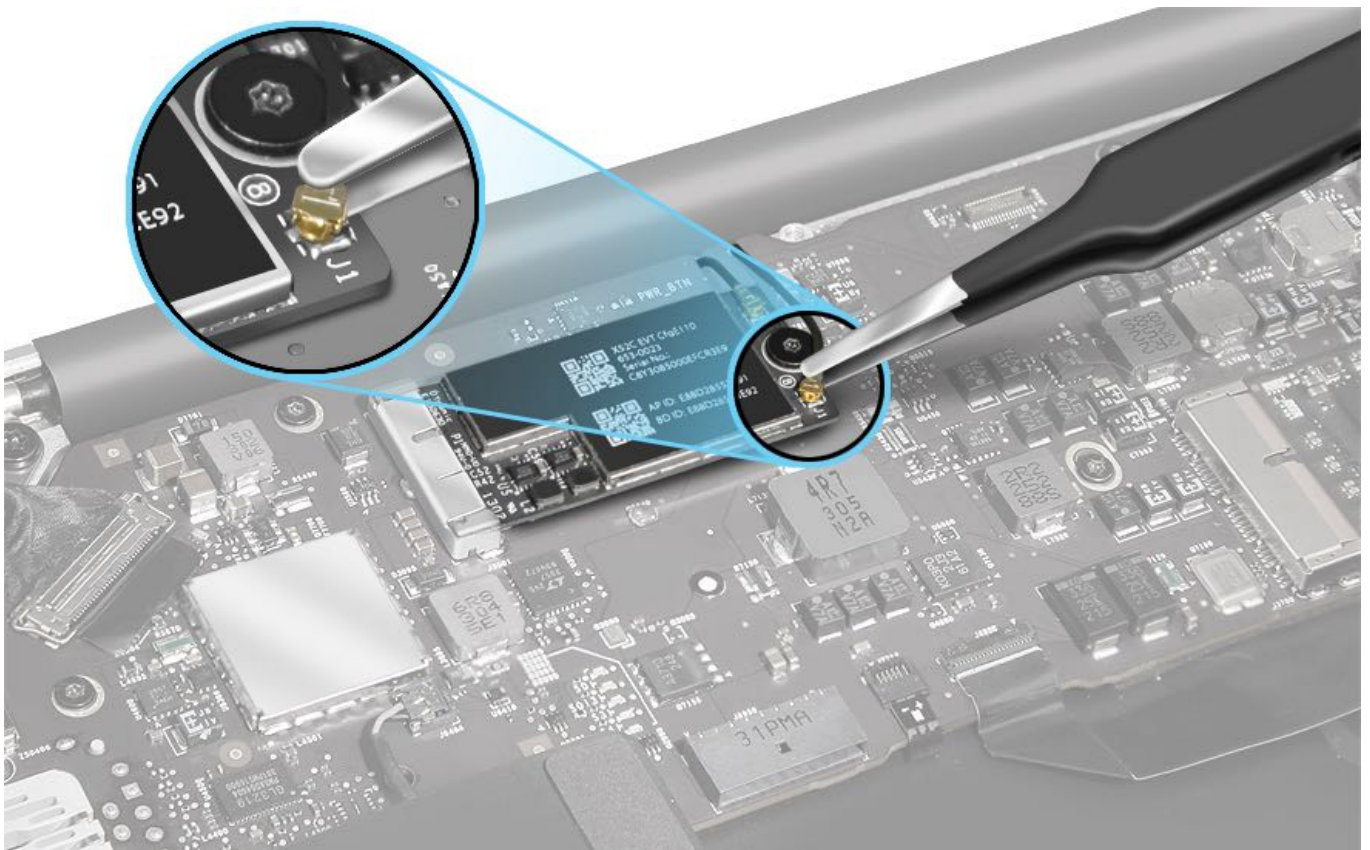
6. Replace remaining heat sink screws in order shown. Install screws halfway first; then tighten in order shown.



7. Reroute antenna cable around screw, under heat sink gasket, into channel along top of logic board, and through notches in logic board next to wireless card.



8. Reconnect antennas to wireless card. Use tweezers to position each connector and then press straight down with a finger or black stick.



Logic Board

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to article [SV158: Logic Board Replacement Video](#).

Remove:

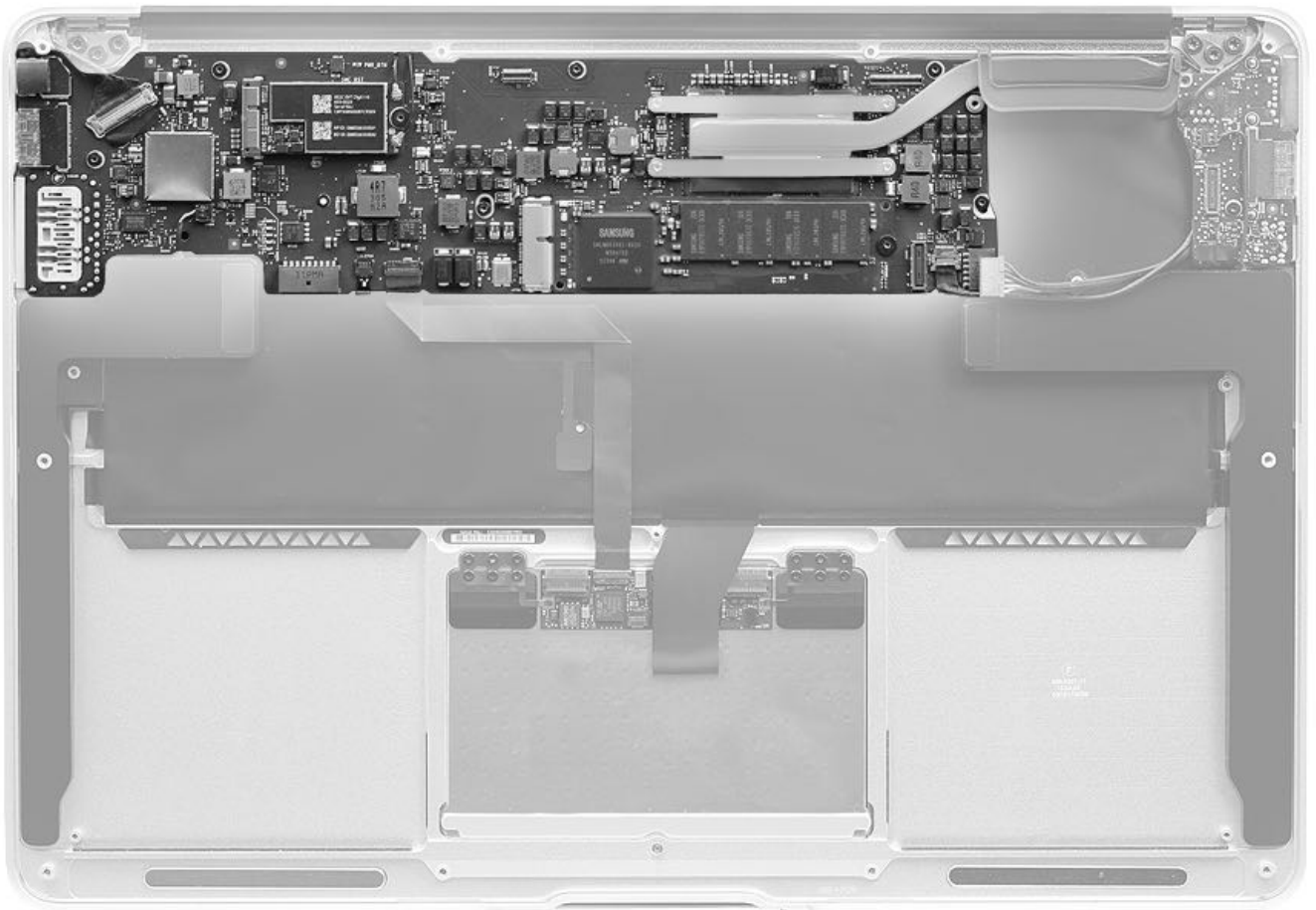
- [Bottom Case](#)
- [Battery](#)
- [Flash Storage](#)
- [Wireless Card](#)
- [I/O Flex Cable](#)
- [Fan](#)

Note: If removing and installing the same logic board, you do not need to remove the flash storage, wireless card, and heat sink.



Important: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board.

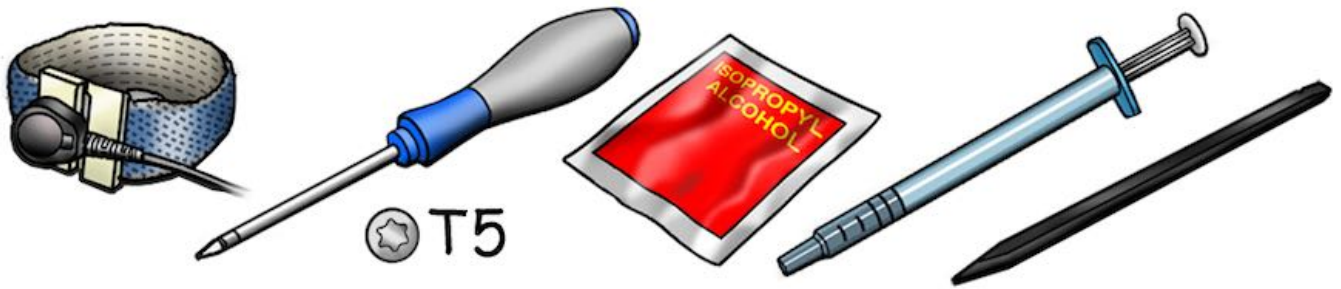
Caution: Read [Battery Safety Precautions](#) before performing this procedure.



Tools

- ESD wrist strap
- Torx T5 screwdriver, magnetized
- Alcohol pads
- Thermal grease syringe (922-7144)

- Black stick



Steps For Removal

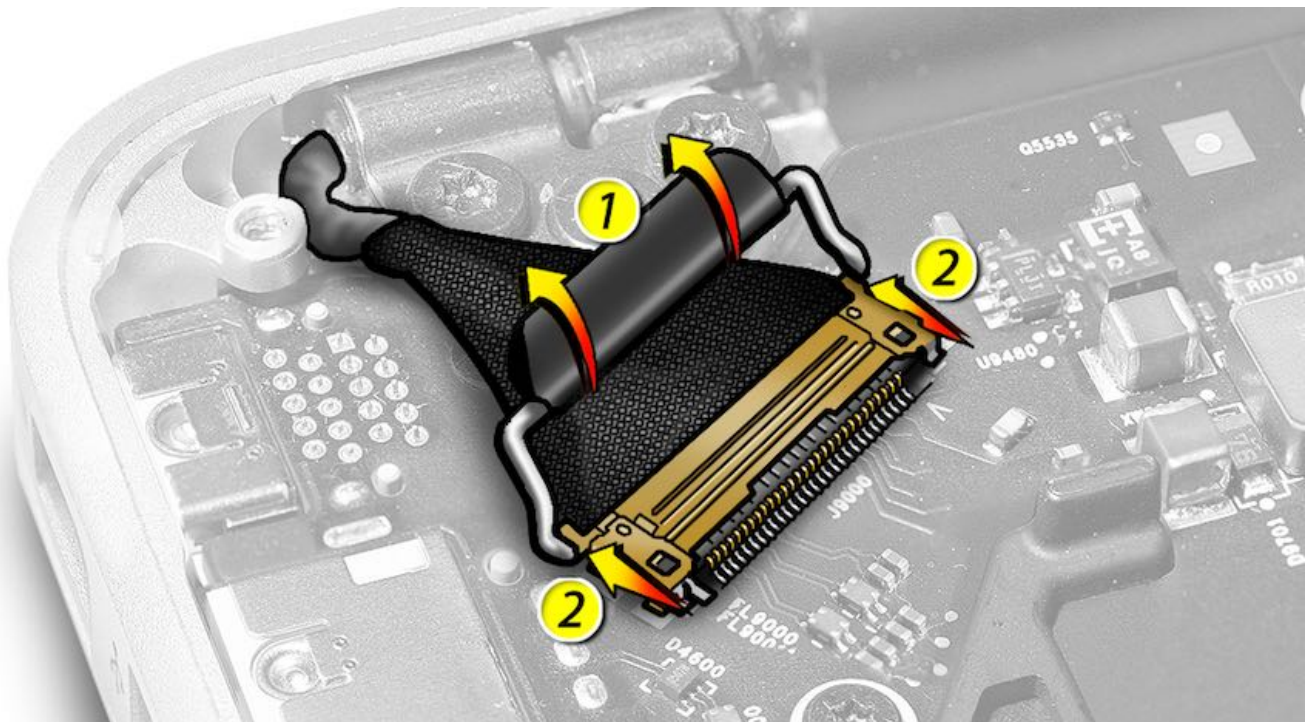


Caution: To avoid flexing original or replacement logic boards:

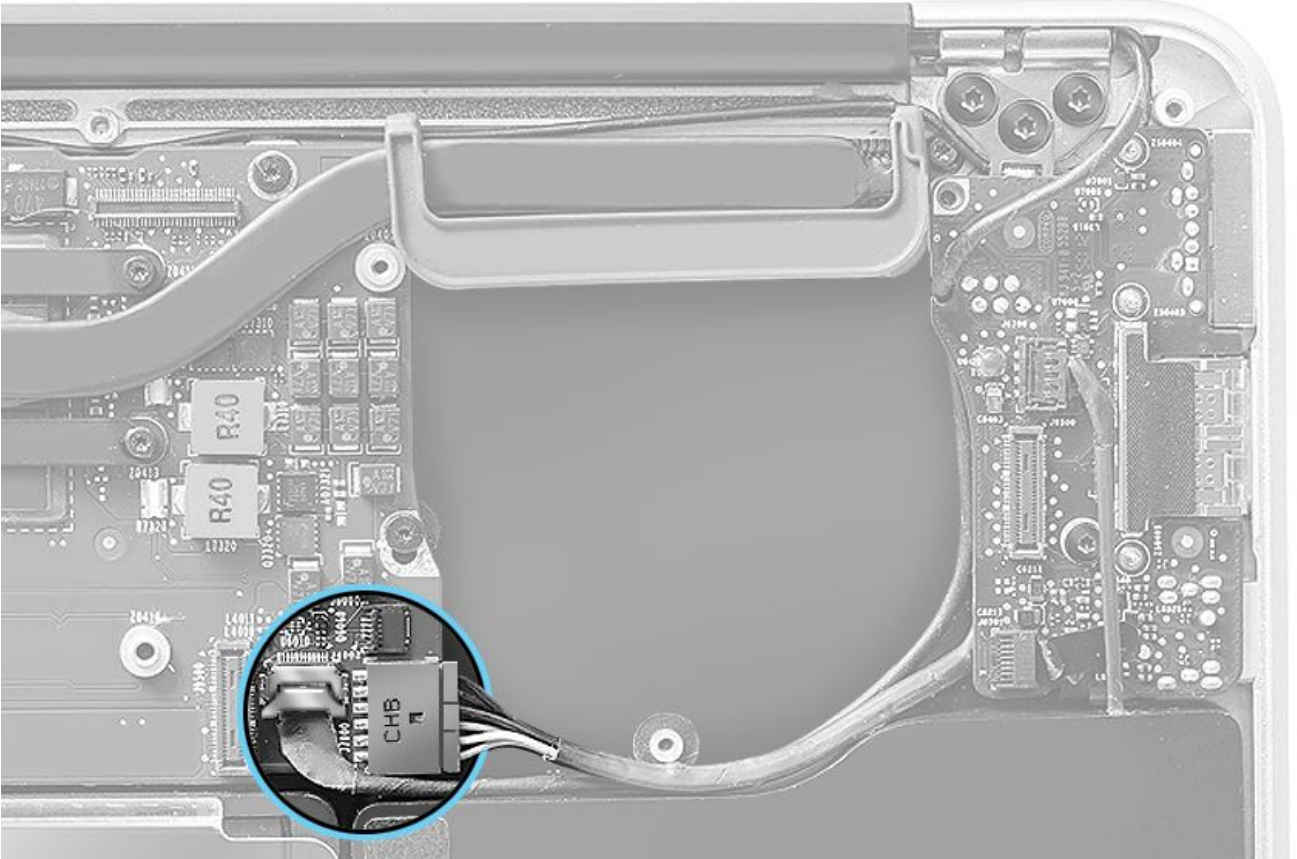
- Remove heat sink from original board while it is still in top case. See [Heat Sink and Heat Sink Gasket](#).
- Install heat sink on replacement board after it is installed in top case.
- If removing/reinstalling same logic board, do not remove heat sink.

1. Disconnect display cable from logic board.

- Gently flip up lock bar to unlock connector (1).
- Use black stick or fingernail to disconnect display cable (2).



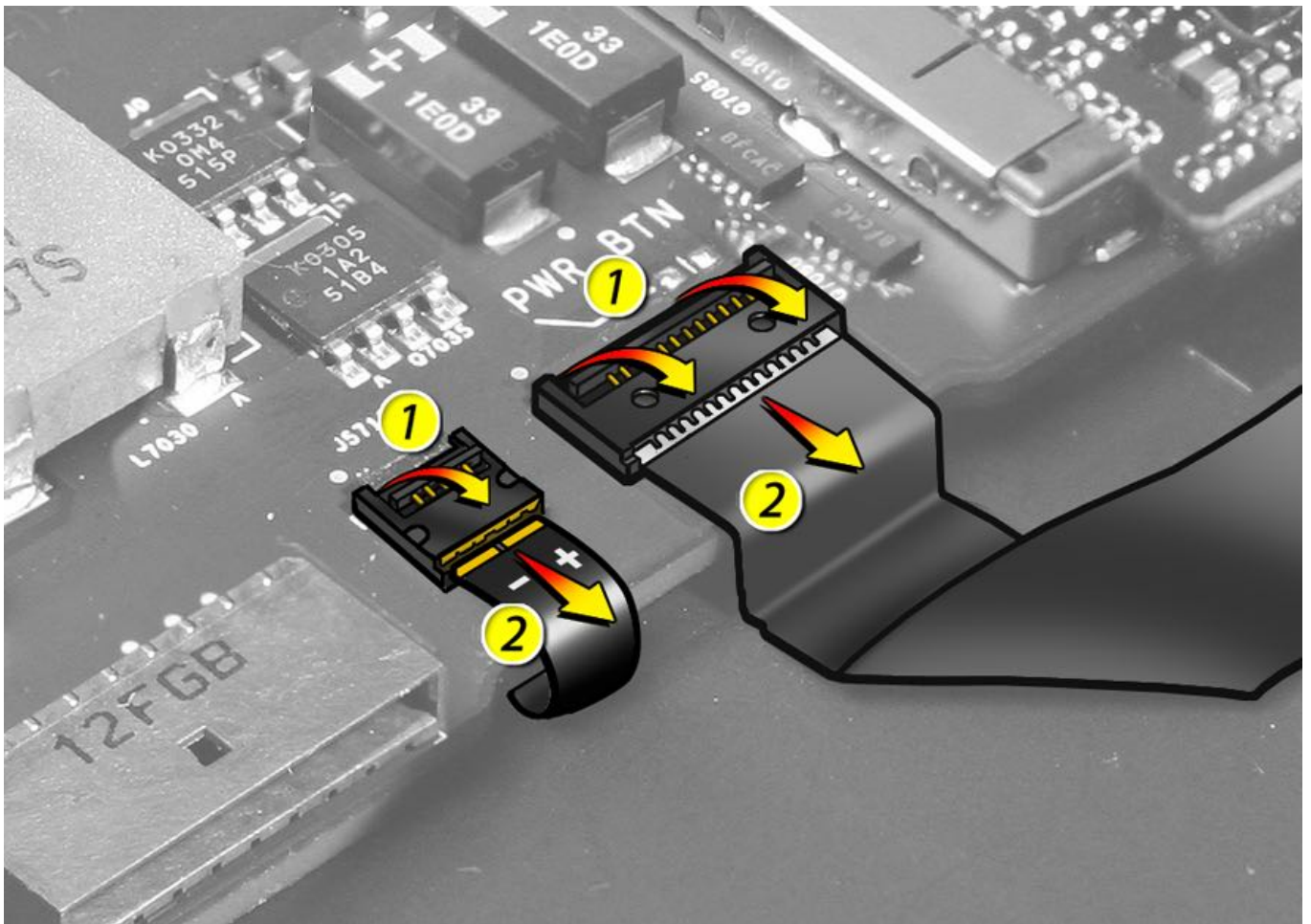
2. If you have not already done so, disconnect the I/O board and camera cables (circled) from logic board.



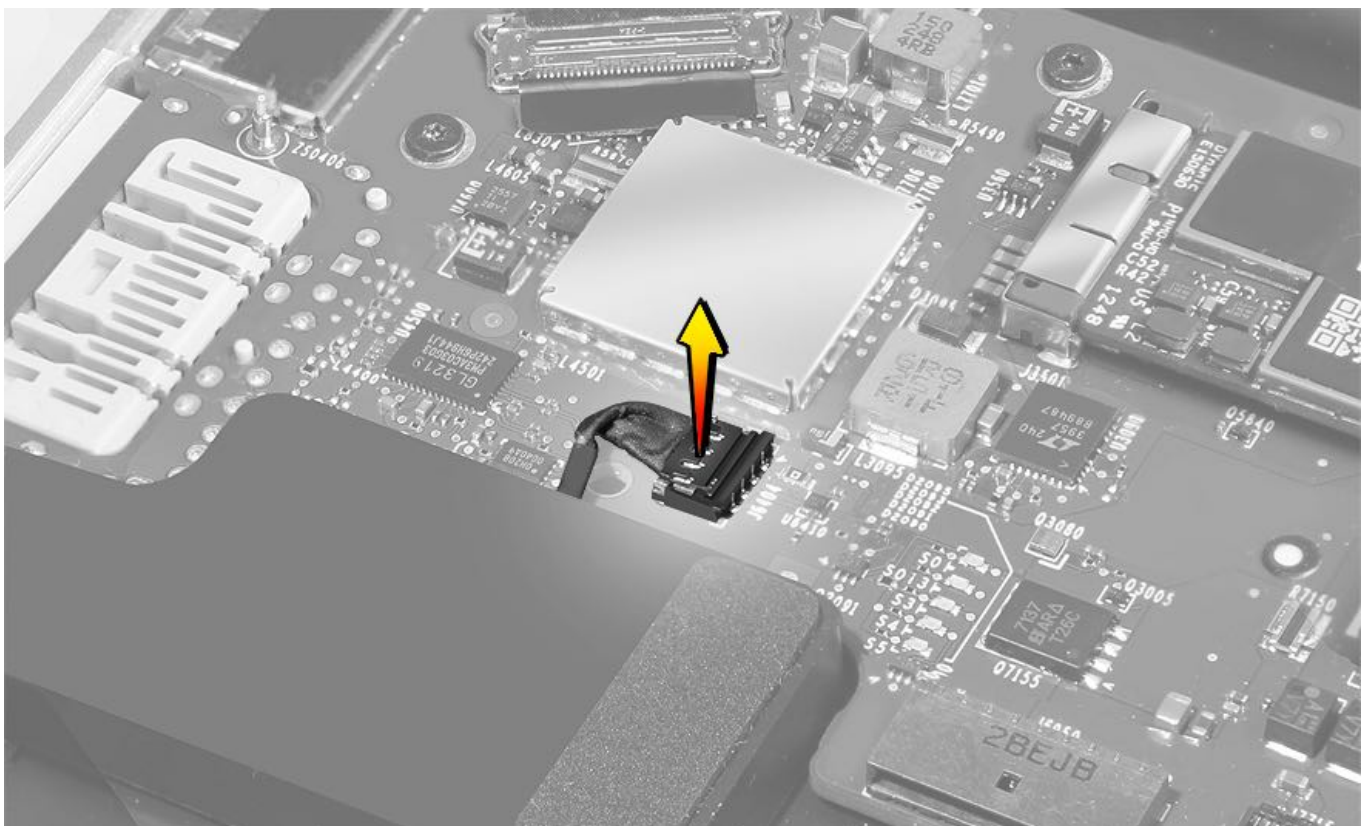
3. On lower edge of logic board, use black stick to flip up locking lever on input device (IPD) cable (on the right). Gently remove IPD cable from logic board connector.

Repeat same procedure for backlight cable.

Note: When returning logic board to Apple, leave fan, IPD, and backlight locking levers in down (closed) position.

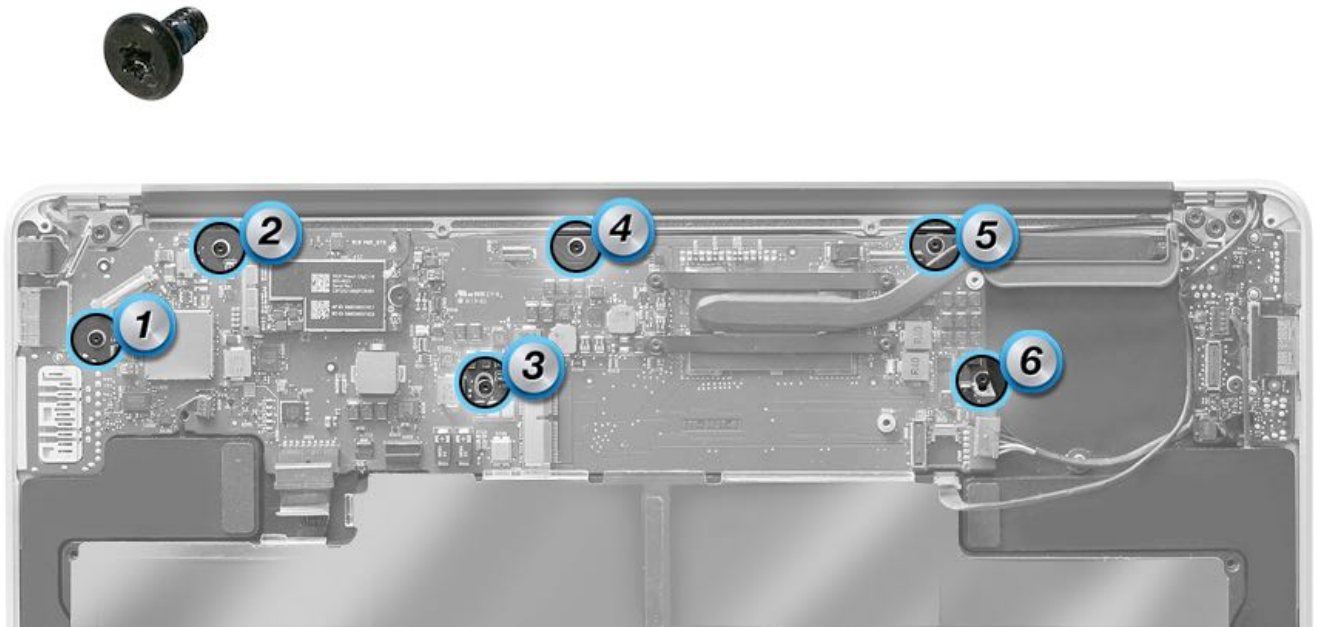


4. Disconnect right speaker cable from logic board.



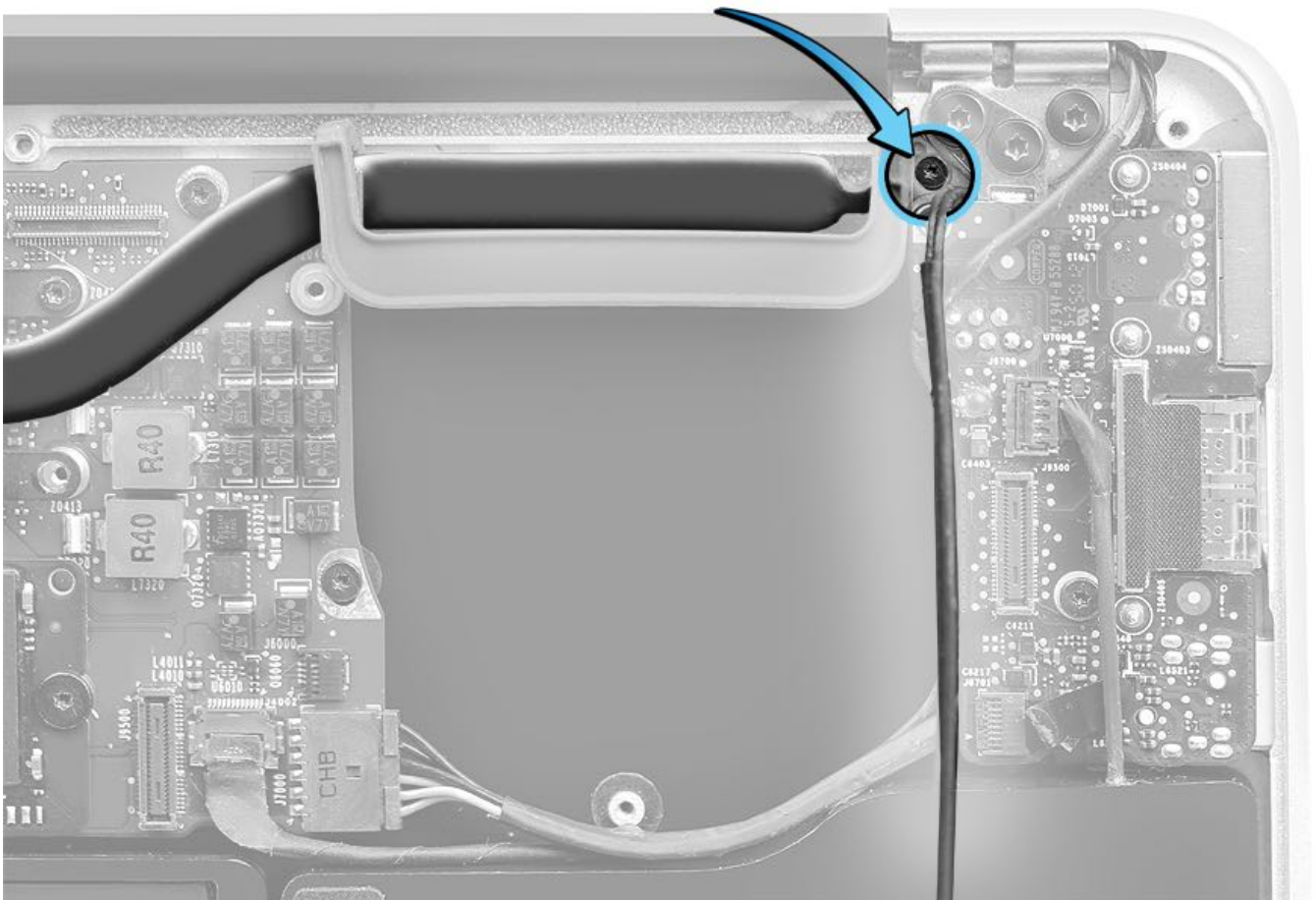
5. Remove six Torx T5 logic board screws:

- T5: 922-9656, 6.3 mm



6. Remove one Torx T5 screw securing heat sink arm:

- T5: 922-9655, 2.4 mm

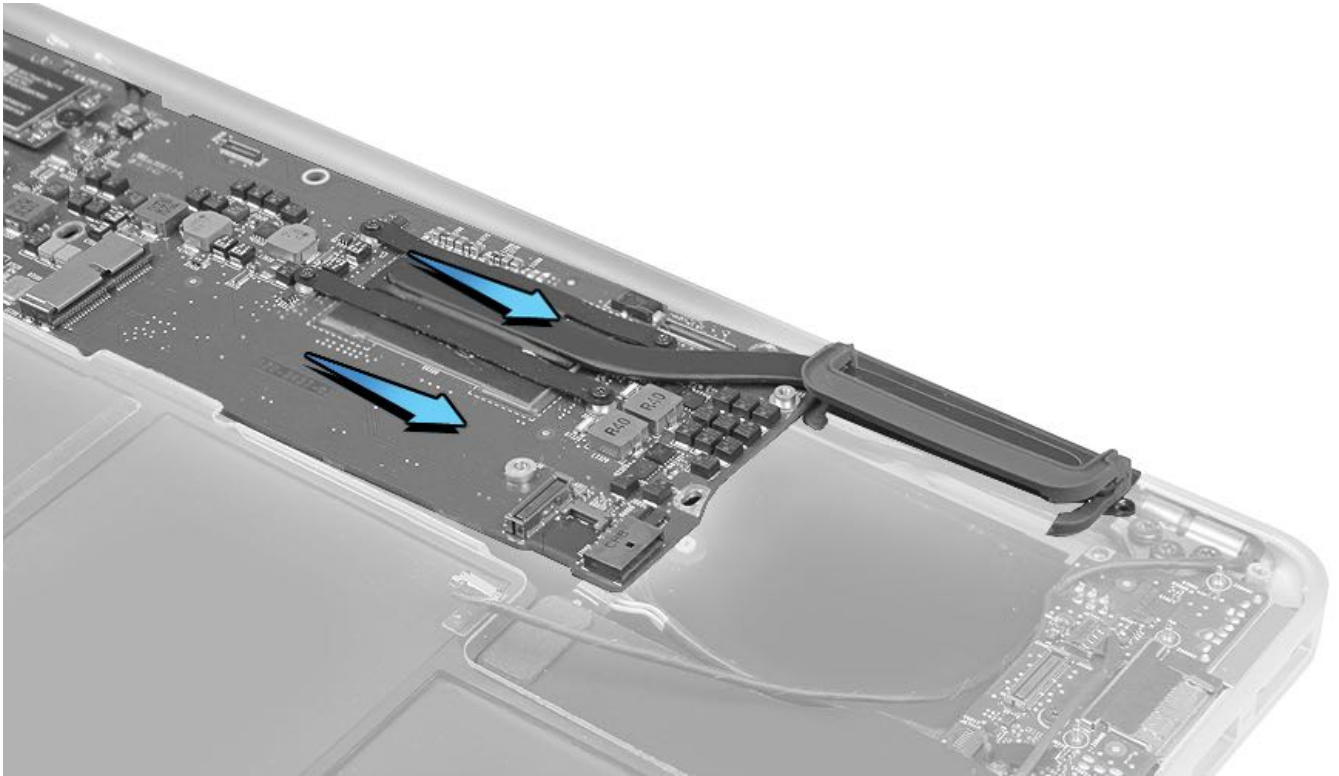


Caution: In the next step, follow safe handling:

- Hold board by edges.
- Do not touch heat sink or connectors.
- Do not touch circuitry.

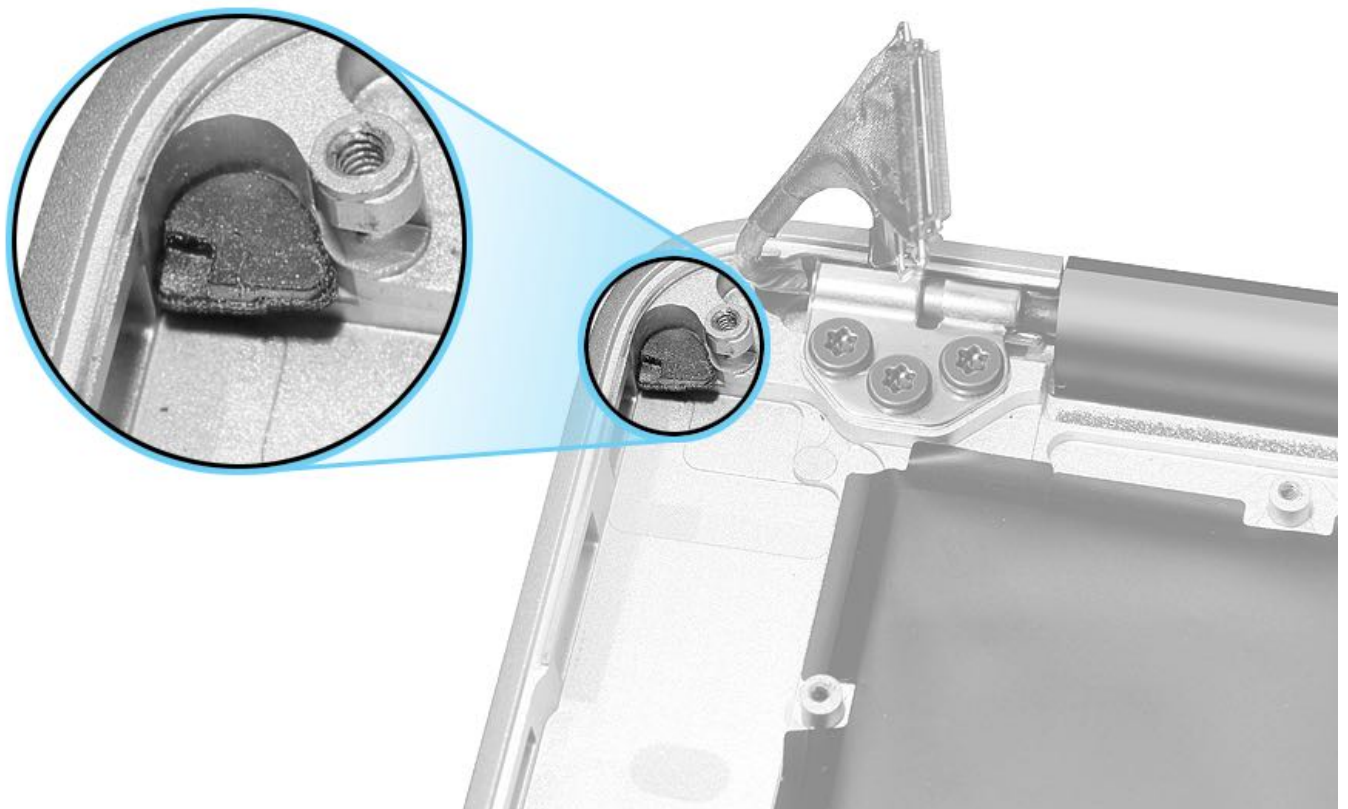
7. If heat sink is in place, carefully free heat sink arm from top case. Then carefully tilt, slightly lift, and remove logic board from ports on top case.

Important: Tilting the board is important to prevent connector damage.



Steps For Reassembly

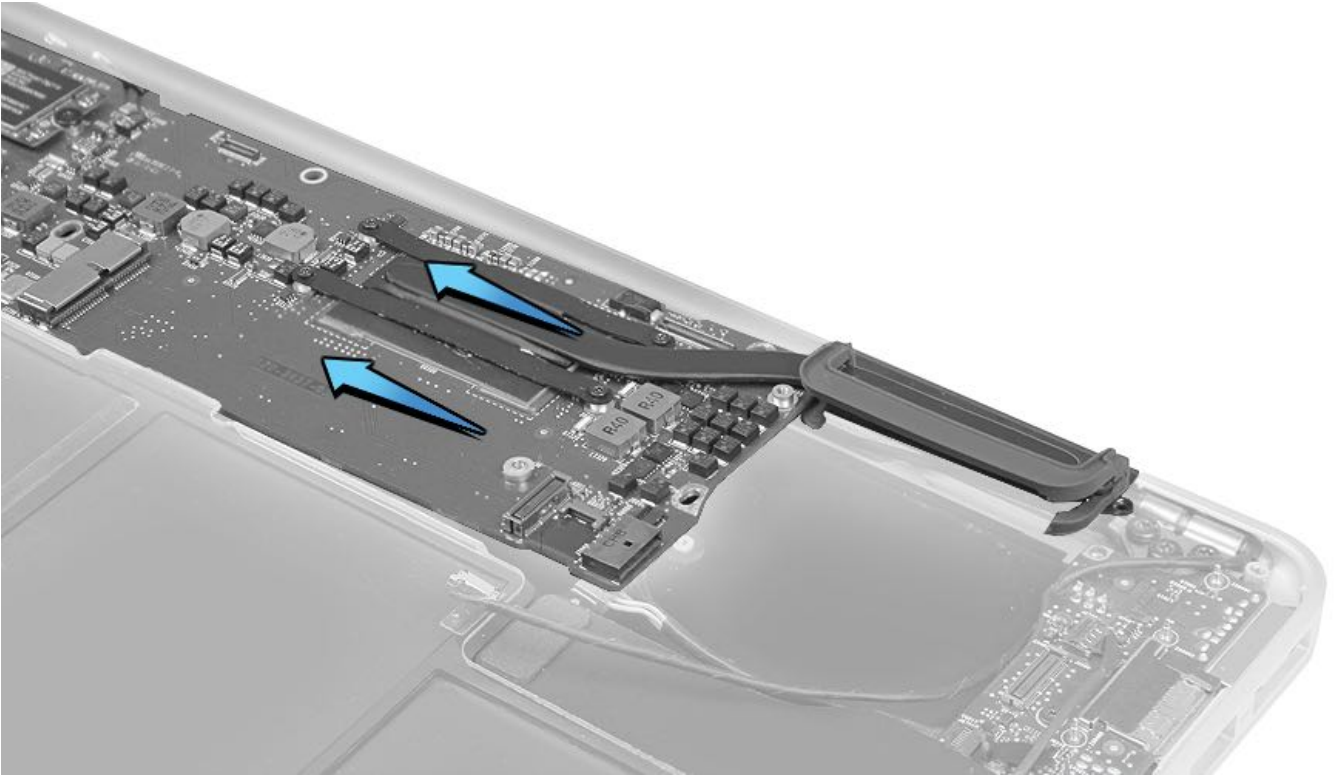
1. Before installing logic board, check upper right corner of top case and make sure rubber gasket is in position, as shown. Reposition if necessary.



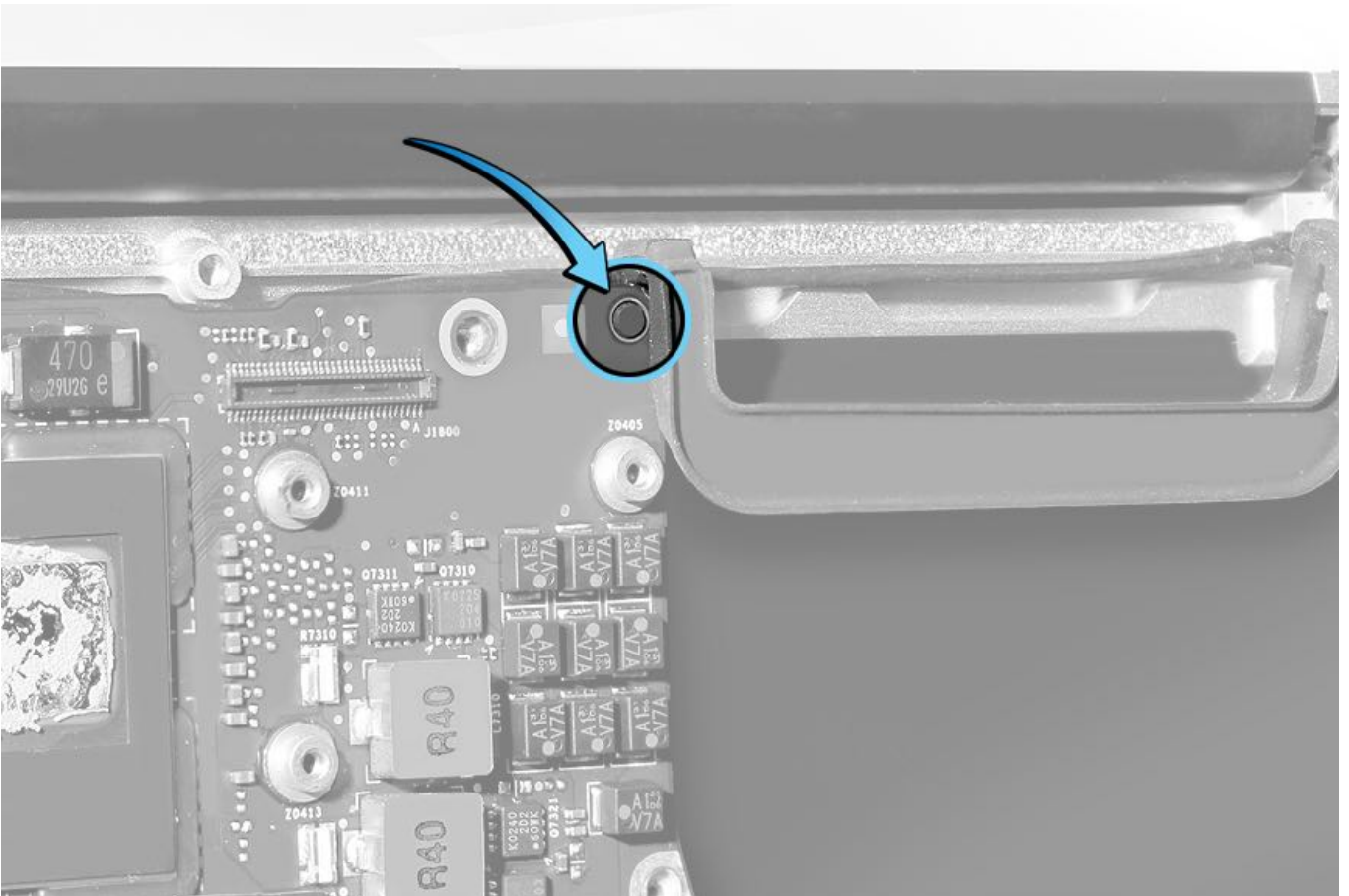
2. Insert Thunderbolt or Mini DisplayPort connector at an angle into opening in top case, using caution to prevent damage to

metal EMI ground tabs. Lower board into place and align logic board screw holes with top case.

Caution: Make sure cables are not pinched underneath board.

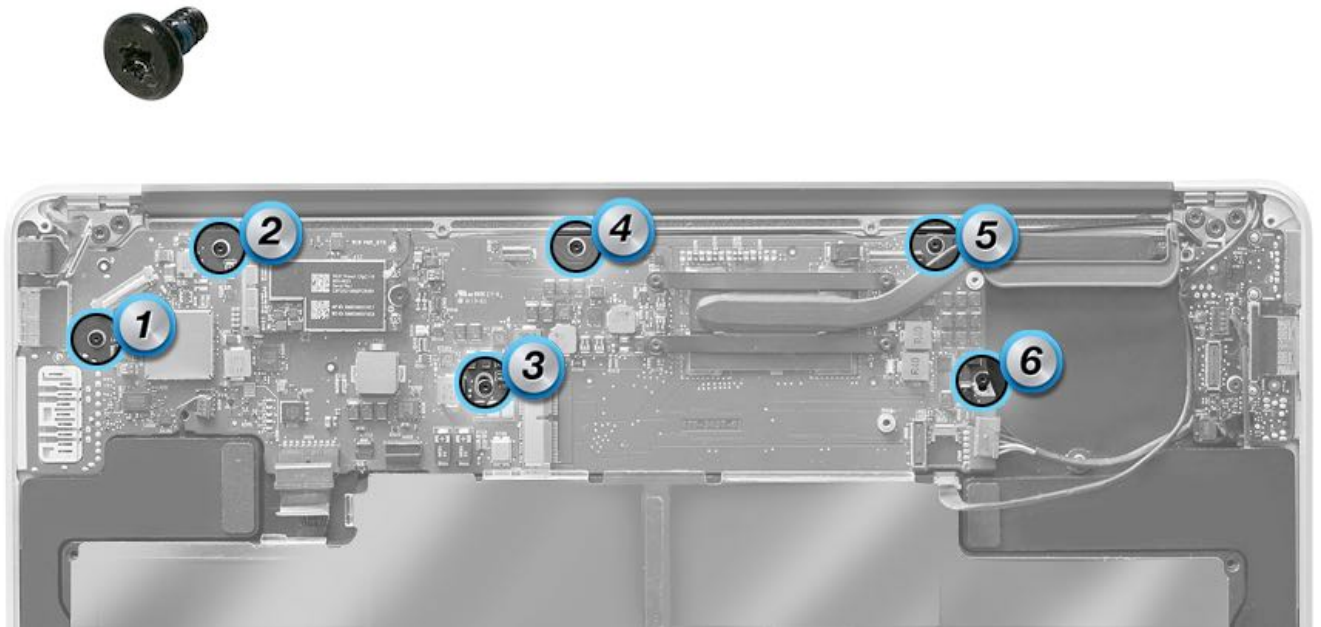


3. Make sure heat sink gasket is installed in mounting hole on logic board.



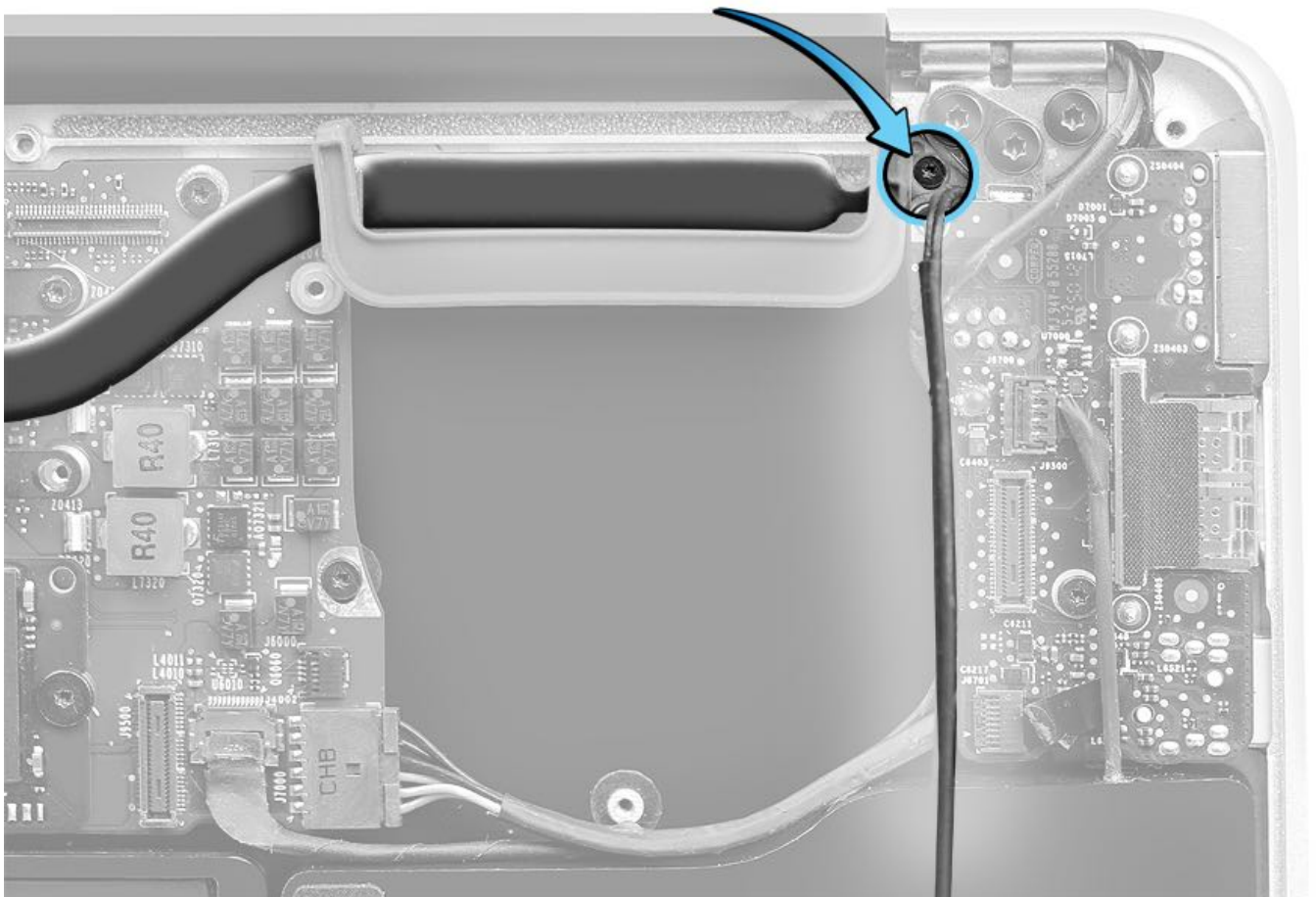
4. Install six Torx T5 screws to logic board in order shown.

- T5: 922-9656, 6.3 mm

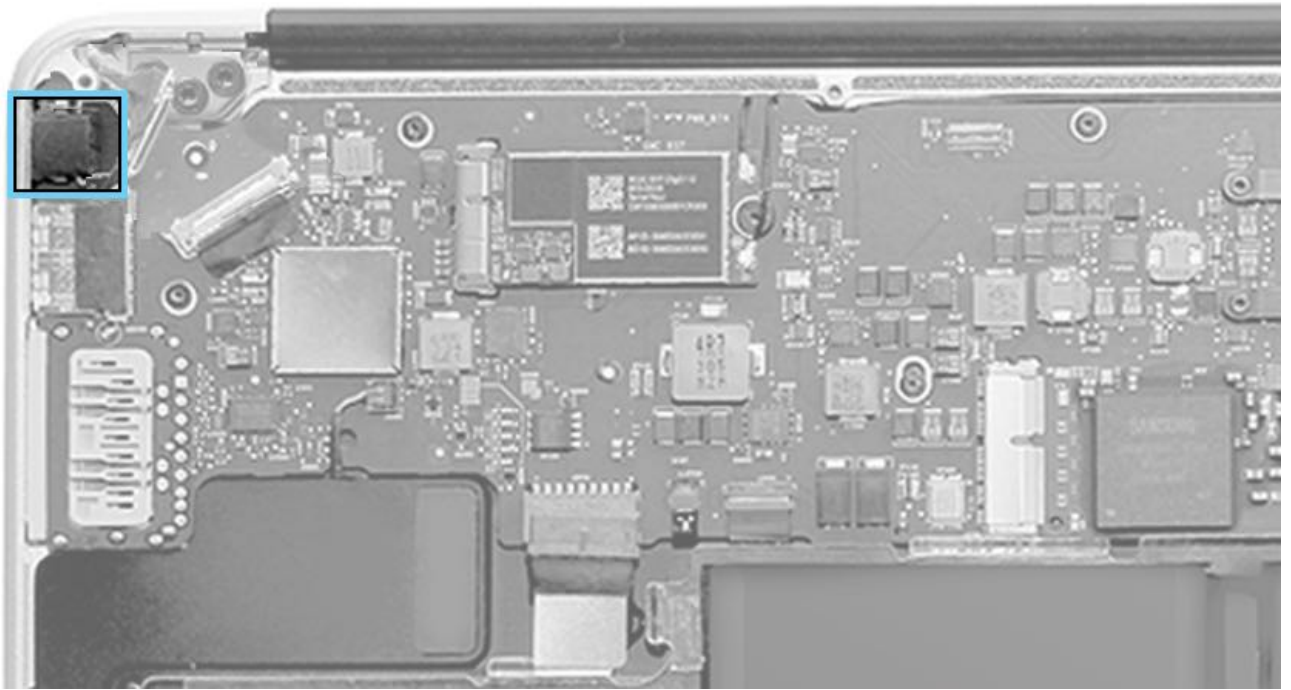


5. Install one Torx T5 screw securing heat sink arm:

- T5: 922-9655, 2.4 mm



6. To reduce the risk of electromagnetic interference (EMI), place the foam pad that is included with the replacement main logic board on the Mini DisplayPort or Thunderbolt port as shown.

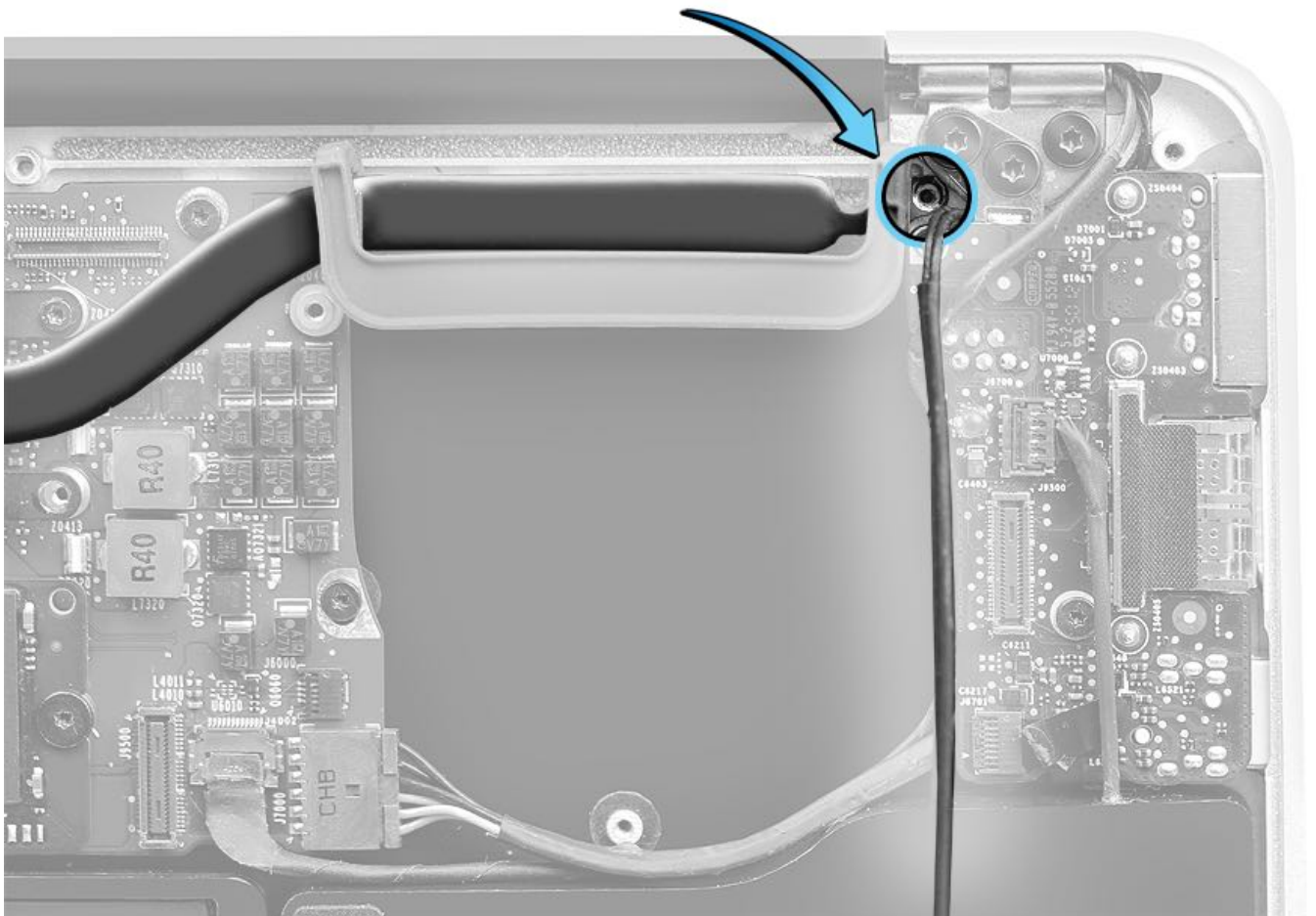


7. If you are installing a replacement logic board, transfer the following to the new board:

- Flash storage
- Wireless card
- Heat sink

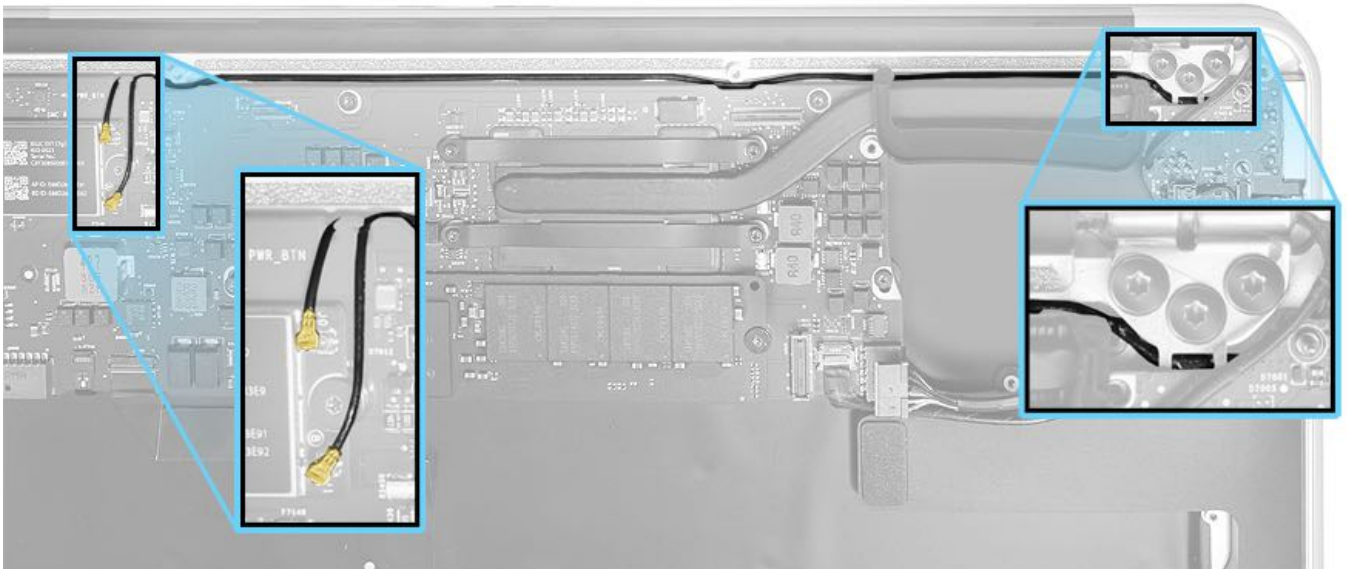
8. Align heat sink arm screw hole with top case standoff. Replace screw.

Note: Be careful not to clip or damage wireless card cable when replacing screw.



9. Reroute antenna cable around screw, under heat sink gasket, into channel along top of logic board, and through notches

in logic board next to wireless card.



10. Reconnect antennas to wireless card.



11. Connect the following cables to the logic board:

- Right speaker
- Backlight
- IPD
- Camera
- I/O board
- Display

12. If you have installed a replacement logic board, use Blank Board Serializer (BBS) to set the computer's serial number after the computer has been reassembled. BBS can be run from AST 1 or AST 2, or as a stand-alone, USB-based version found in article [SD63: Blank Board Serializer](#).

- For more information about AST and supported Mac models, see article [OP476: Latest Apple Service Toolkit download links and documentation](#).
- **Important:** When using BBS in AST 1 or AST 2, ensure that the unit under test (UUT) and the AST server are

connected to the same network, and that the AST server has the latest software version installed.

Trackpad

First Steps

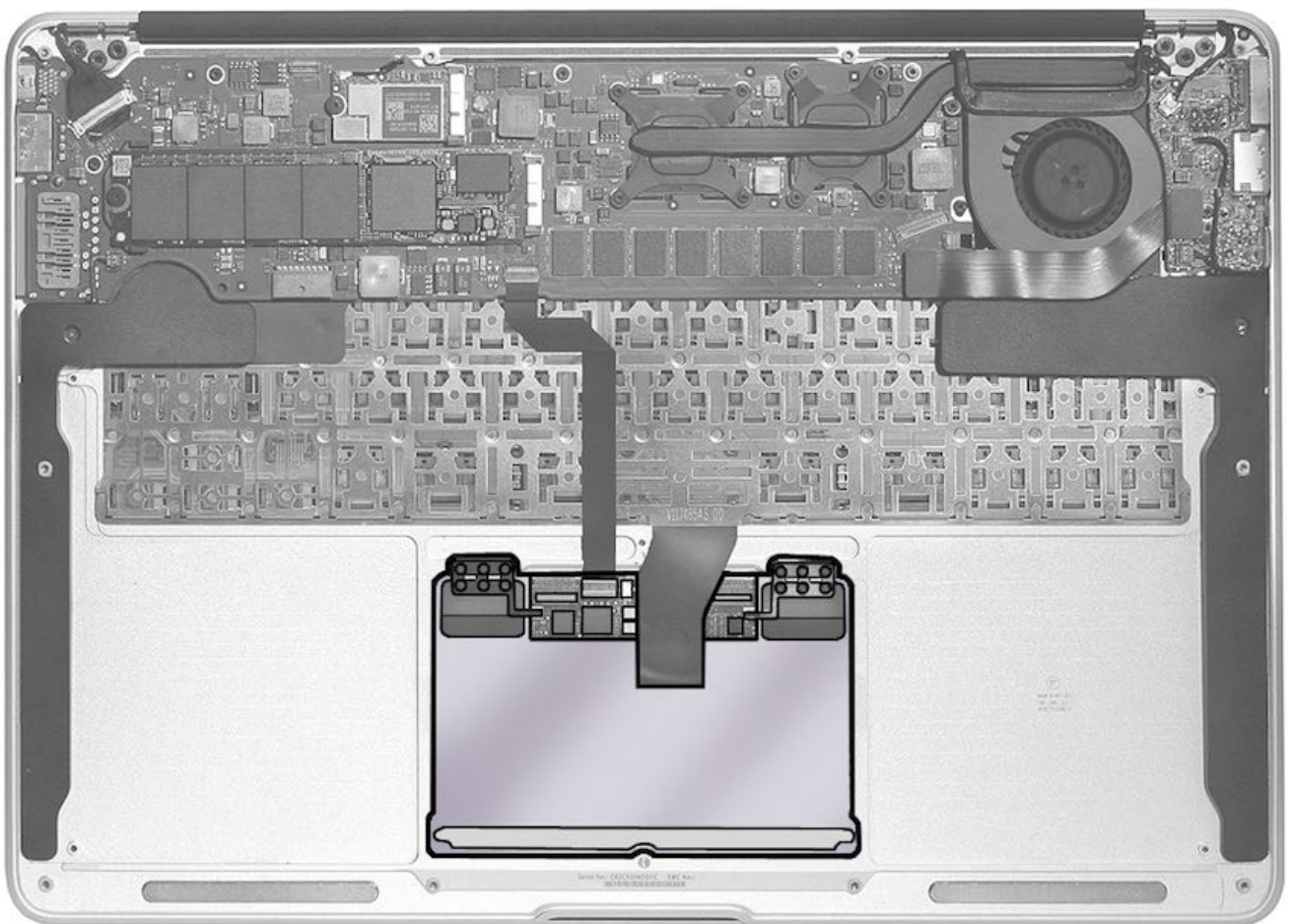
Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

Remove:

- [Bottom Case](#)
- [Battery](#)

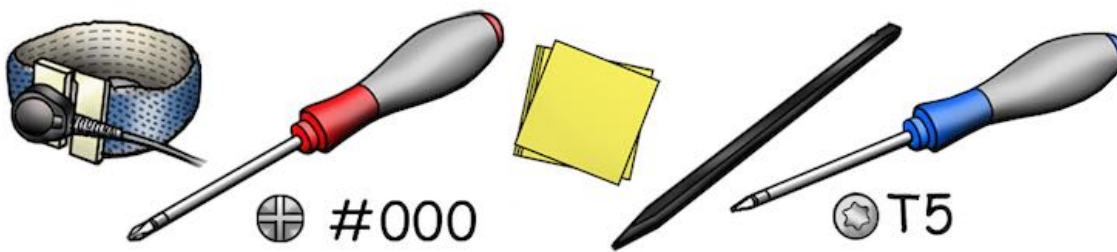


Caution: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board. Read [Battery Safety Precautions](#) before beginning this procedure.



Tools

- ESD wrist strap
- Phillips #000 screwdriver, magnetized
- Sticky notes
- Black stick
- Torx T5 screwdriver



Note: Trackpad kit (923-0438) includes:

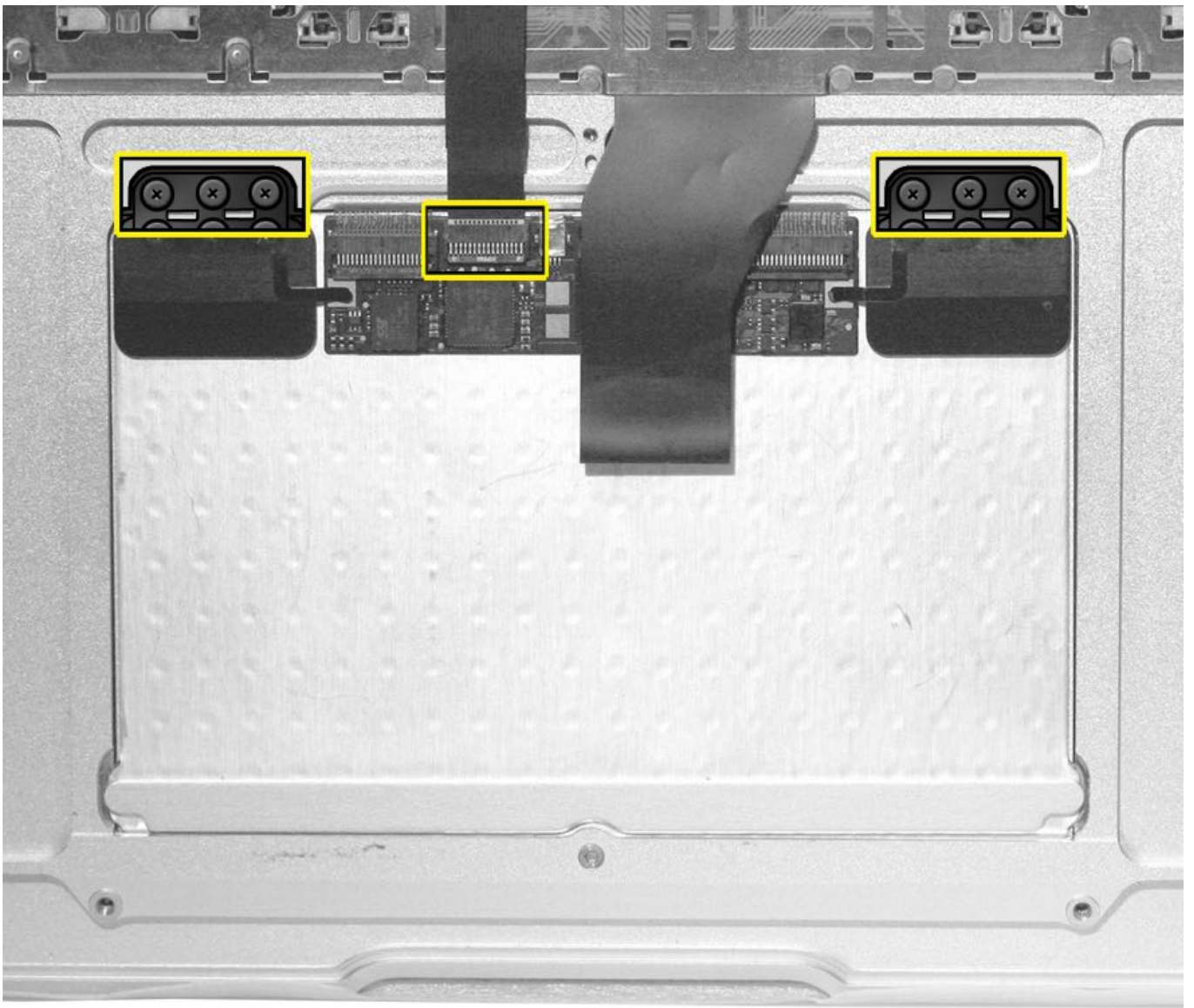
- trackpad
- 2 metal flexures
- flexure screws
- set screw

Steps For Removal

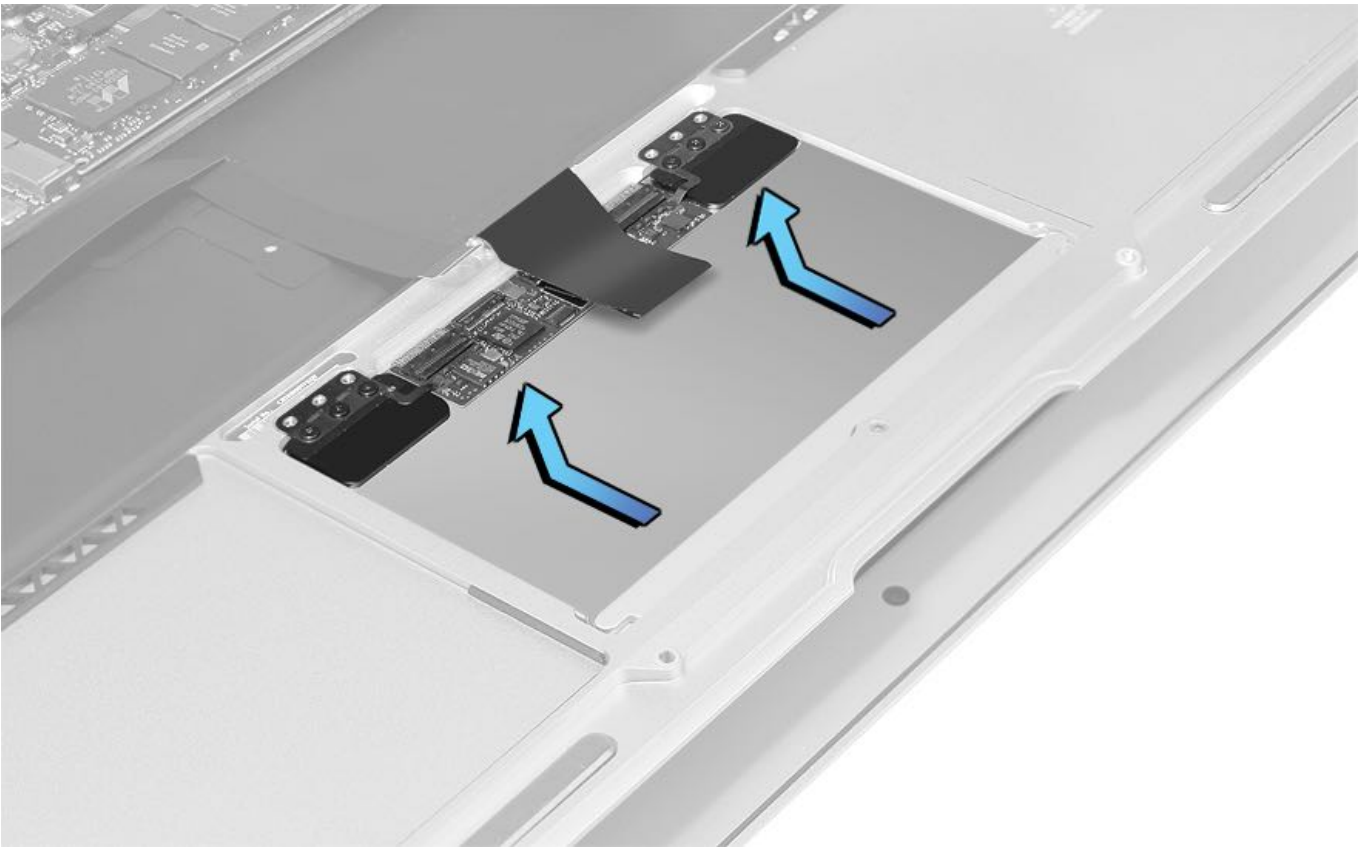
1. Place protective cloth over display.
2. Flip up locking lever to disconnect IPD cable from trackpad. Pull cable toward keyboard.
3. Remove six Phillips #000 screws from flexures (the three screws on the top row of each of the two flexures).
 - 922-9658, 1.47 mm



Note: If installing a new trackpad, discard old screws, as they lose their ability to hold securely when reused. Use new screws included with trackpad kit.

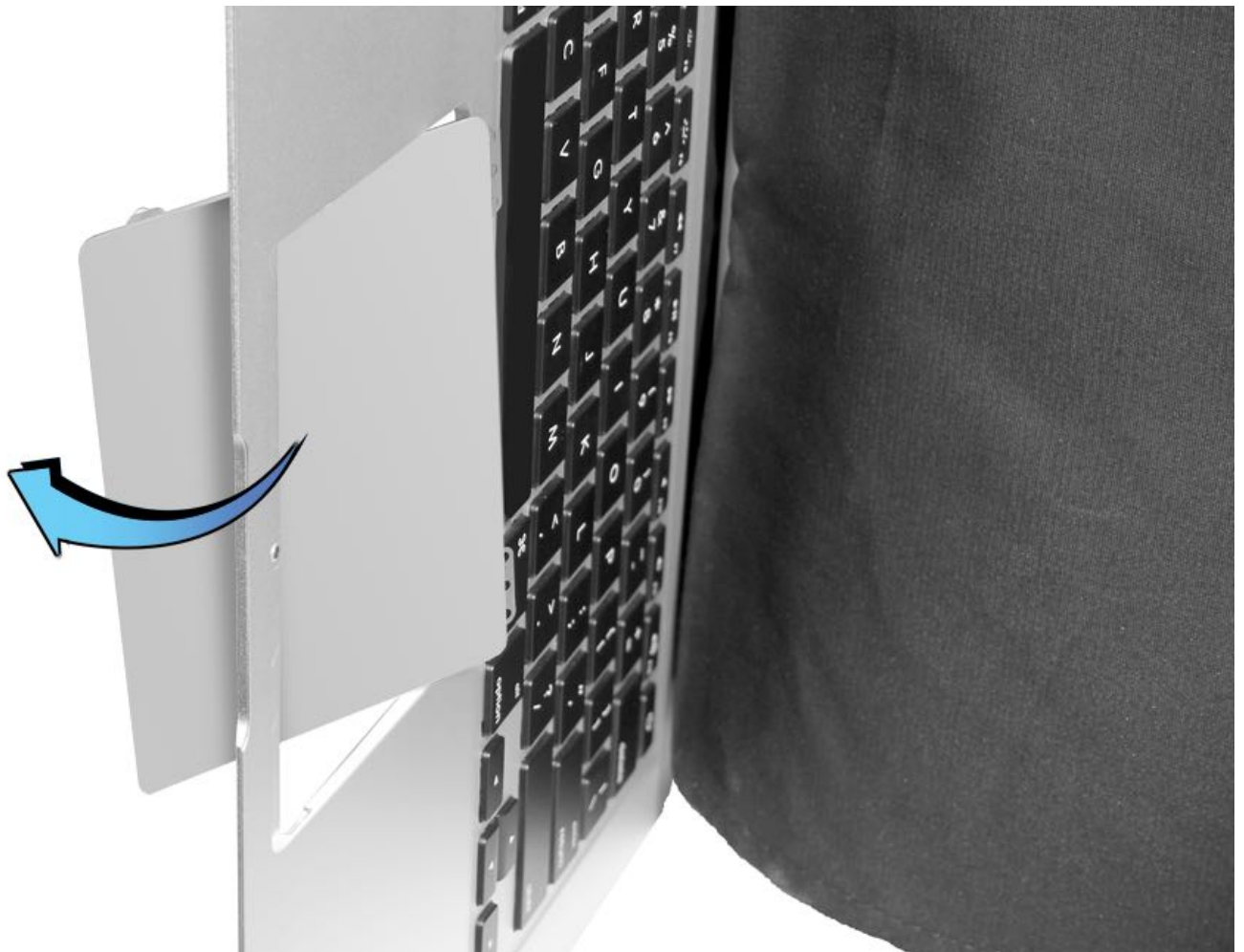


4. With keyboard flex cable still connected, lift top case and push trackpad toward keyboard until bottom lip of trackpad clears top case.

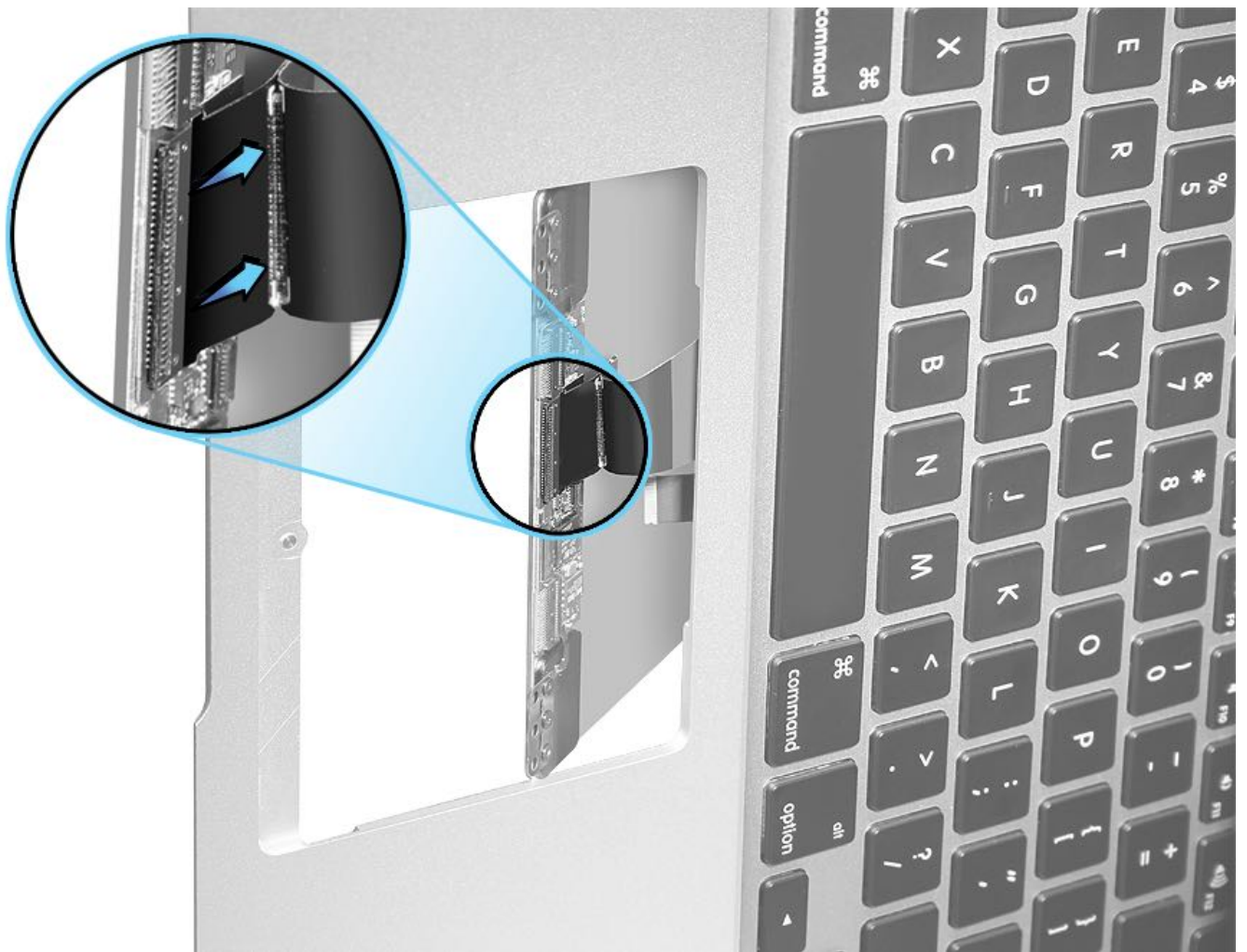


5. While supporting the trackpad, open computer display to 90 degrees and place computer vertically.

6. Without straining flex cable, carefully turn trackpad over.

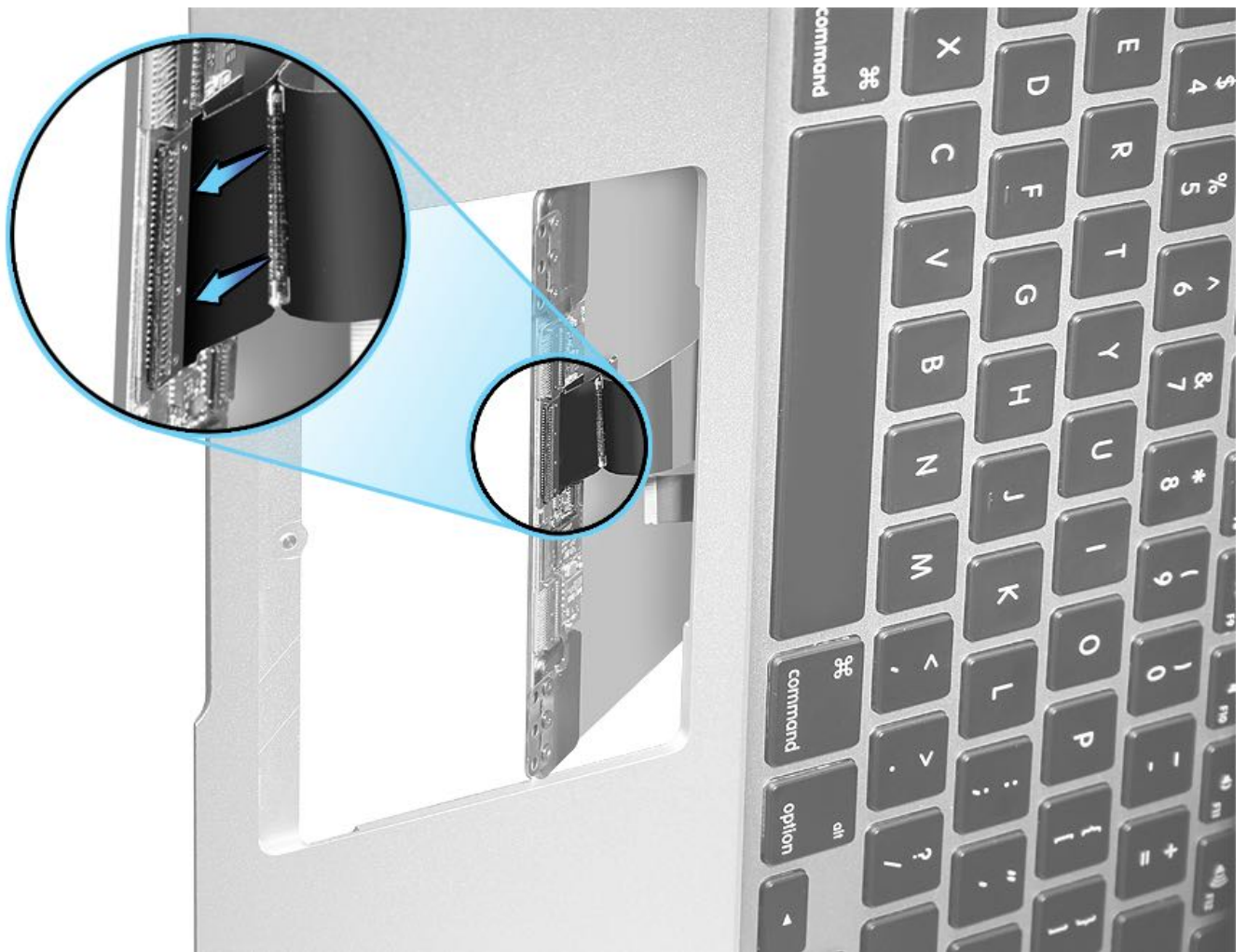


7. Flip up locking lever, disconnect keyboard flex cable from trackpad, and remove trackpad from top case.



Steps For Reassembly

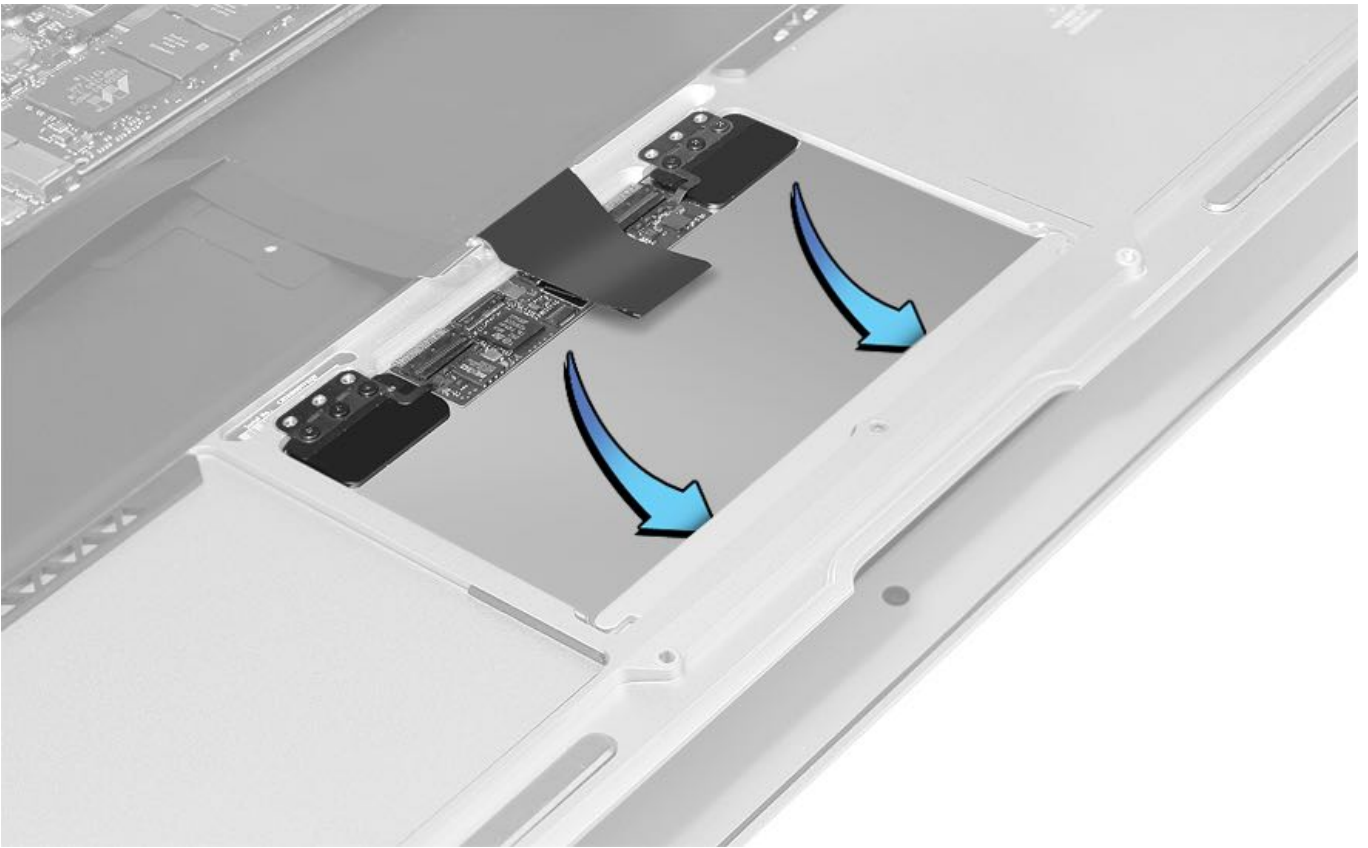
1. With display open and computer placed vertically, connect keyboard flex cable to trackpad. Verify cable is seated properly before locking lever.



2. Rotate trackpad (bottom lip first) into top case.

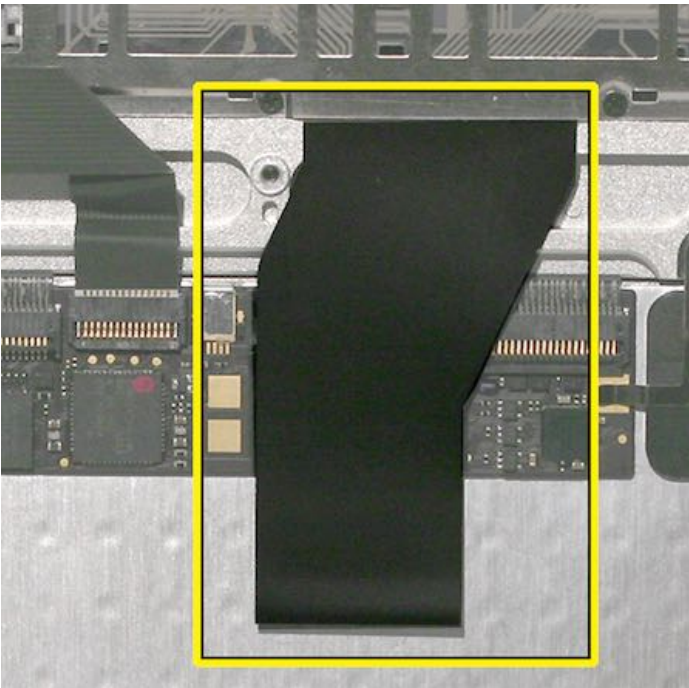
Caution:

- Be extremely careful not to scratch trackpad against top case during installation, especially along lower front edge, where there is a protrusion on top case for set screw. Scratches on silver trackpad will create black spots when viewed from user side of trackpad.
- Minimize rubbing edges of trackpad against top case while installing. This could cause tiny cracks to form on trackpad.



3. Check that keyboard flex cable lies flat against trackpad.

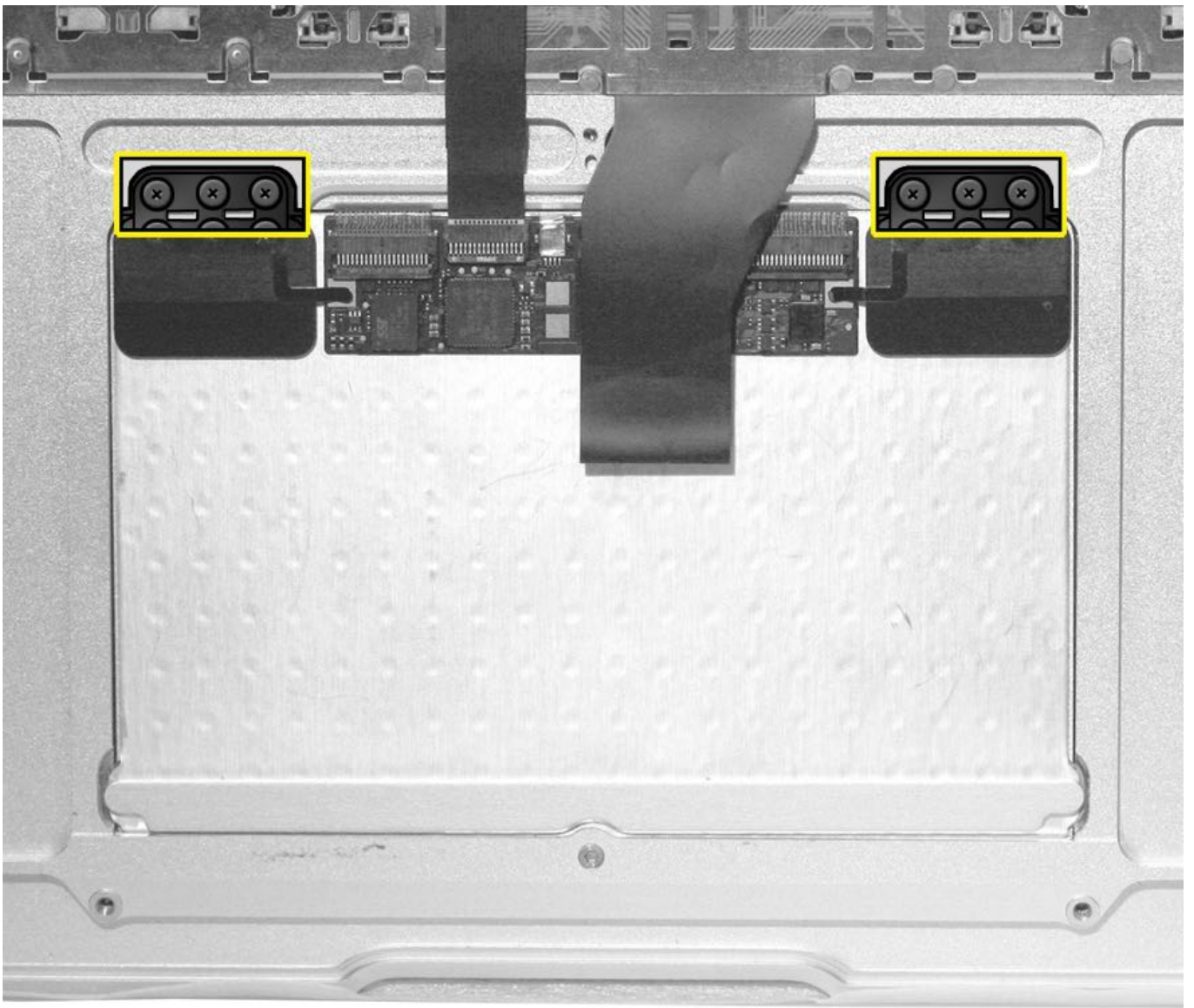
Important: Keyboard flex cable MUST lie flat. Very high bond (VHB) adhesive holds bend in cable. If VHB adhesive or cable is compromised, trackpad alignment issues may occur. This may necessitate top case replacement.



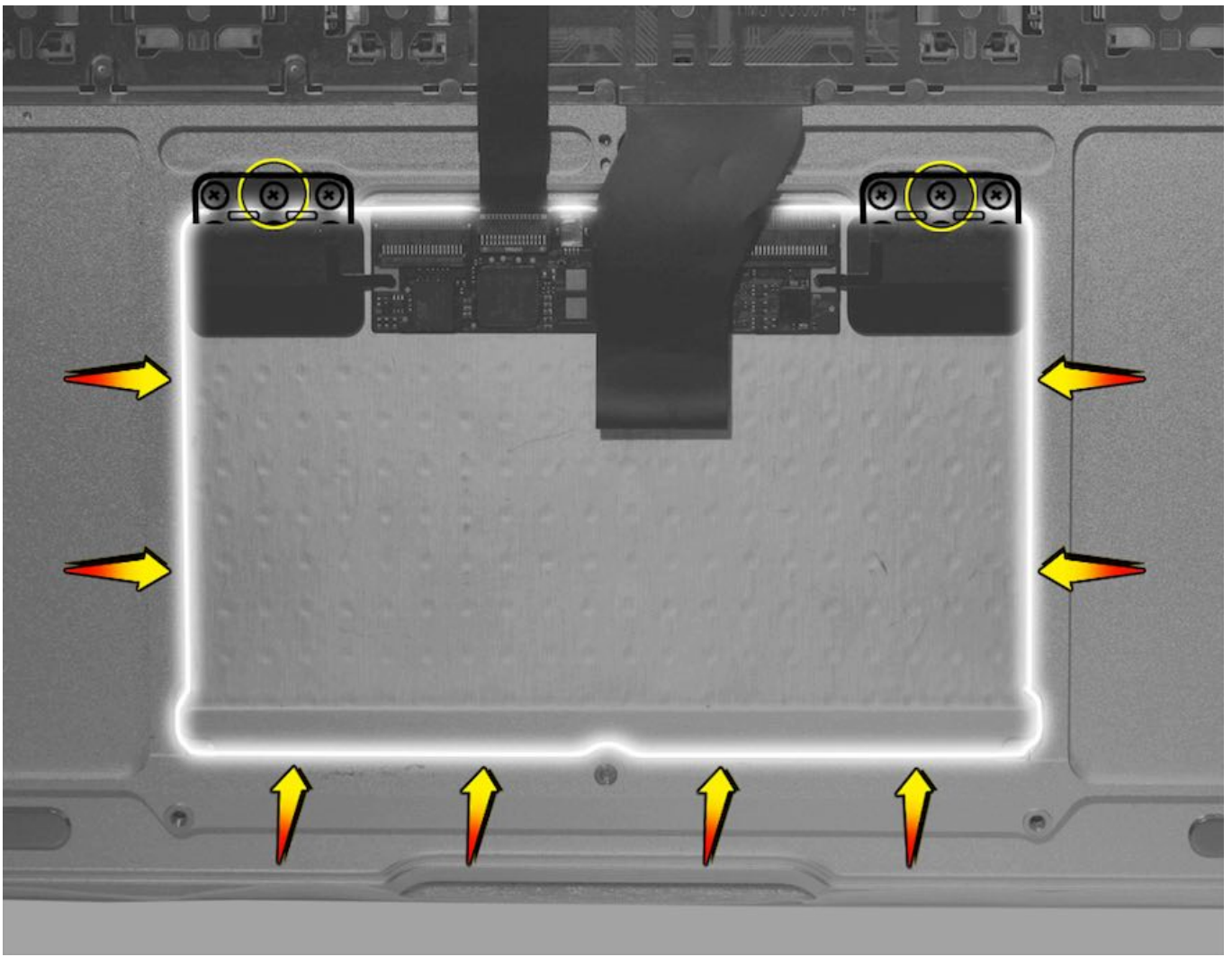
4. Using screws included in trackpad kit, loosely insert six Phillips #000 screws in flexures. Do not tighten yet.

- 922-9658, 1.47 mm





5. Check for even trackpad alignment at top, bottom, and sides by holding top case up to light. Look for even gaps.
6. With even gaps verified, tighten two center screws just enough to provide light tension on trackpad for easy alignment.



7. Prior to securing last four screws, double-check trackpad alignment using sticky (Post-it) notes on palm-rest side of trackpad. Insert **one** note into gap on top and sides of trackpad and **two** notes stacked on top of each other into gap on bottom of trackpad.

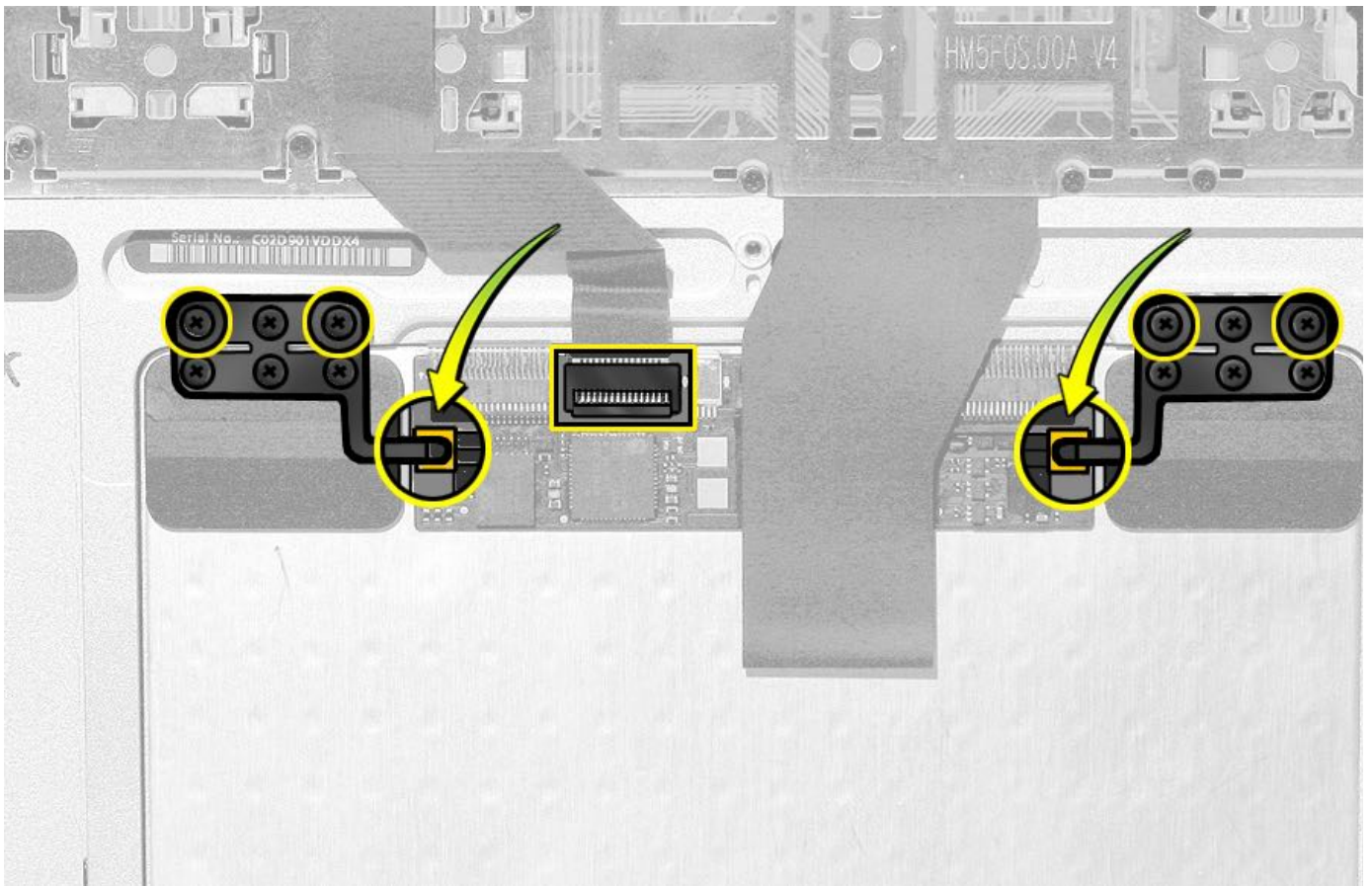
8. Slide notes back and forth on all four sides to assure even spacing.



9. Tilt up case to secure final four screws.

10. Make sure flexure arms are touching the copper pads.

11. Connect IPD flex cable.

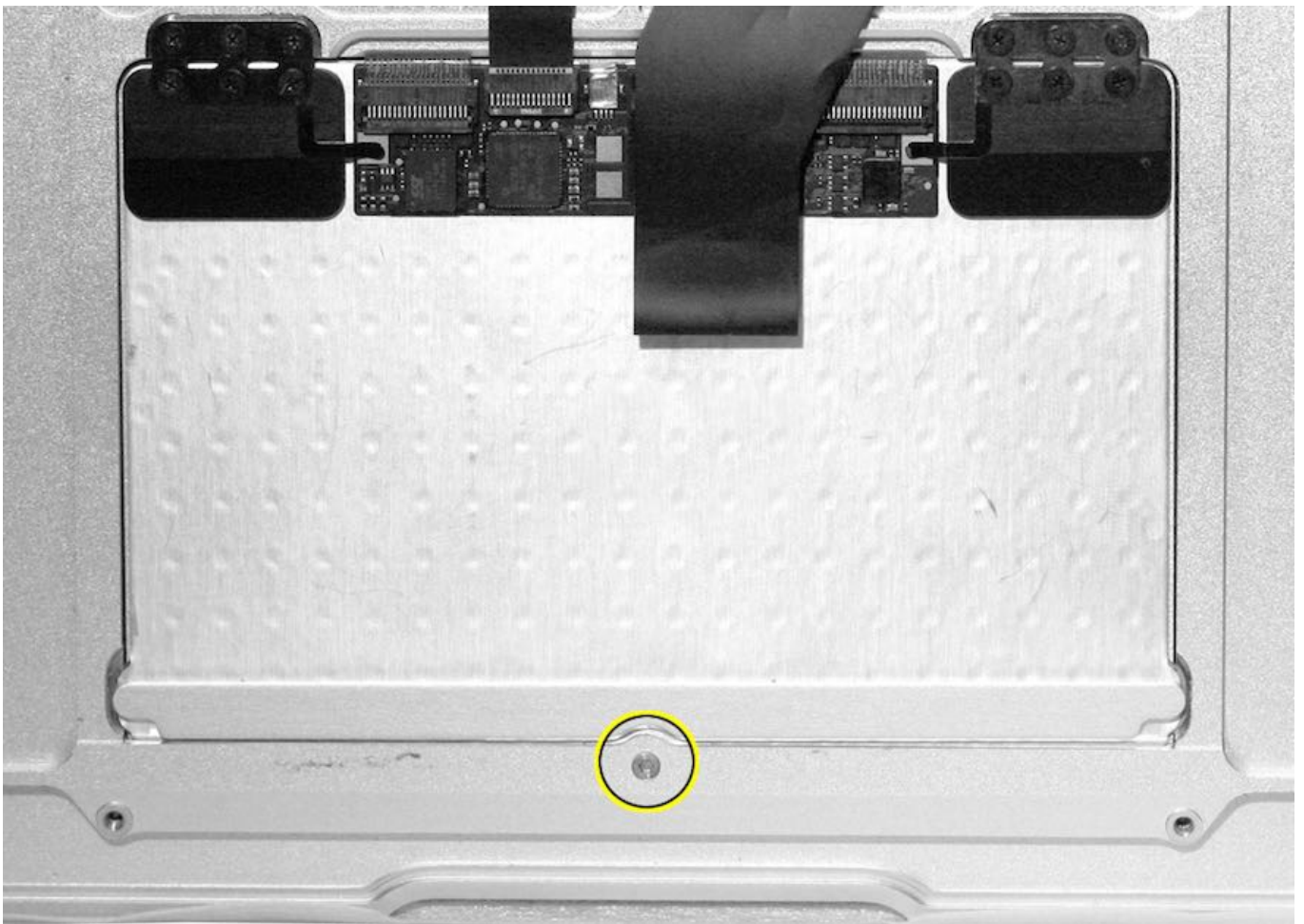


12. If you are installing trackpad in a new top case, loosely adjust T5 set screw and go to next step.

- T5: 922-9732, 1.47 mm

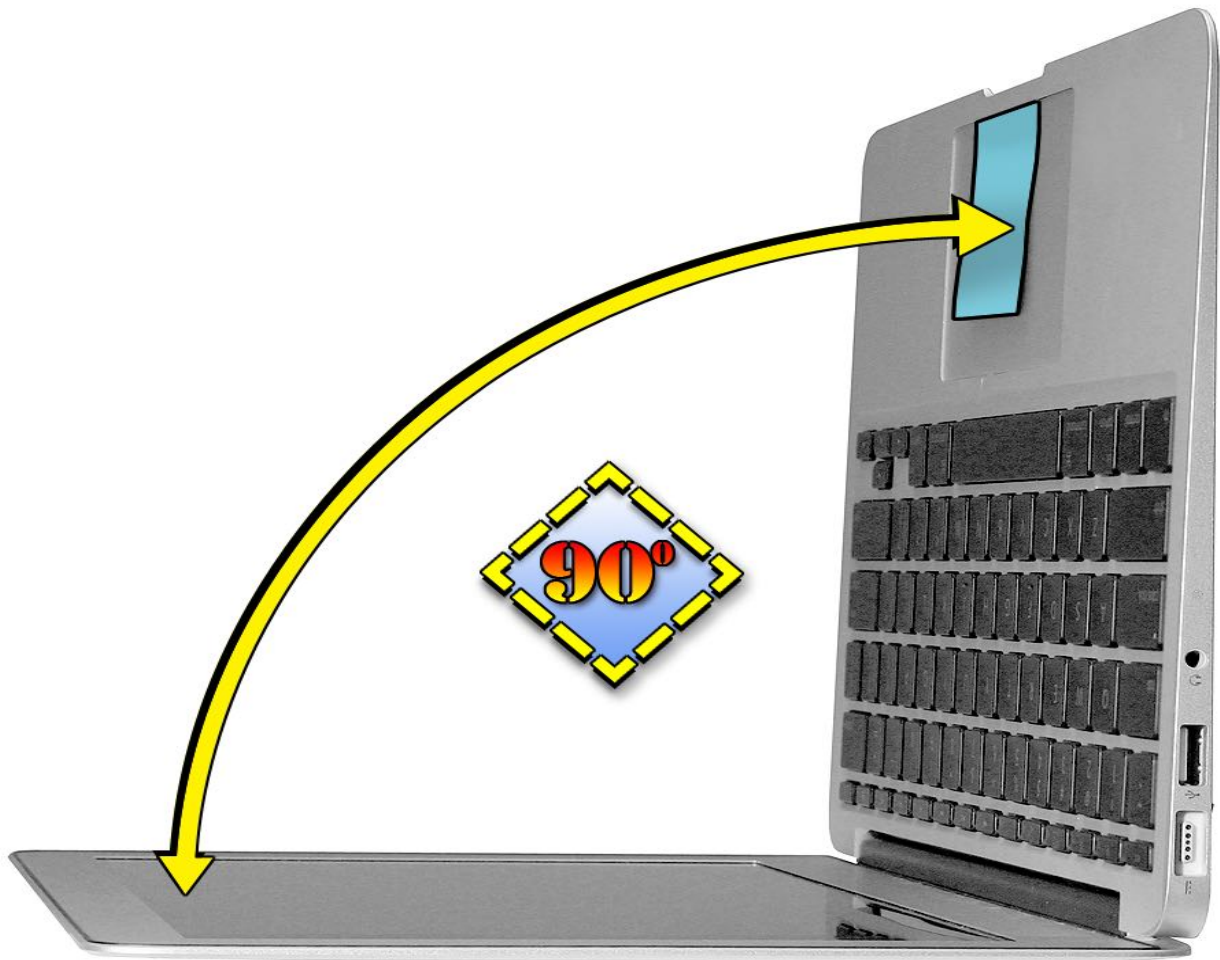


Important: If you are installing trackpad in existing top case, do not adjust set screw, but check trackpad for normal clicking motion and reassemble computer.



13. Place top case vertically and align one sticky note to bottom edge of trackpad.

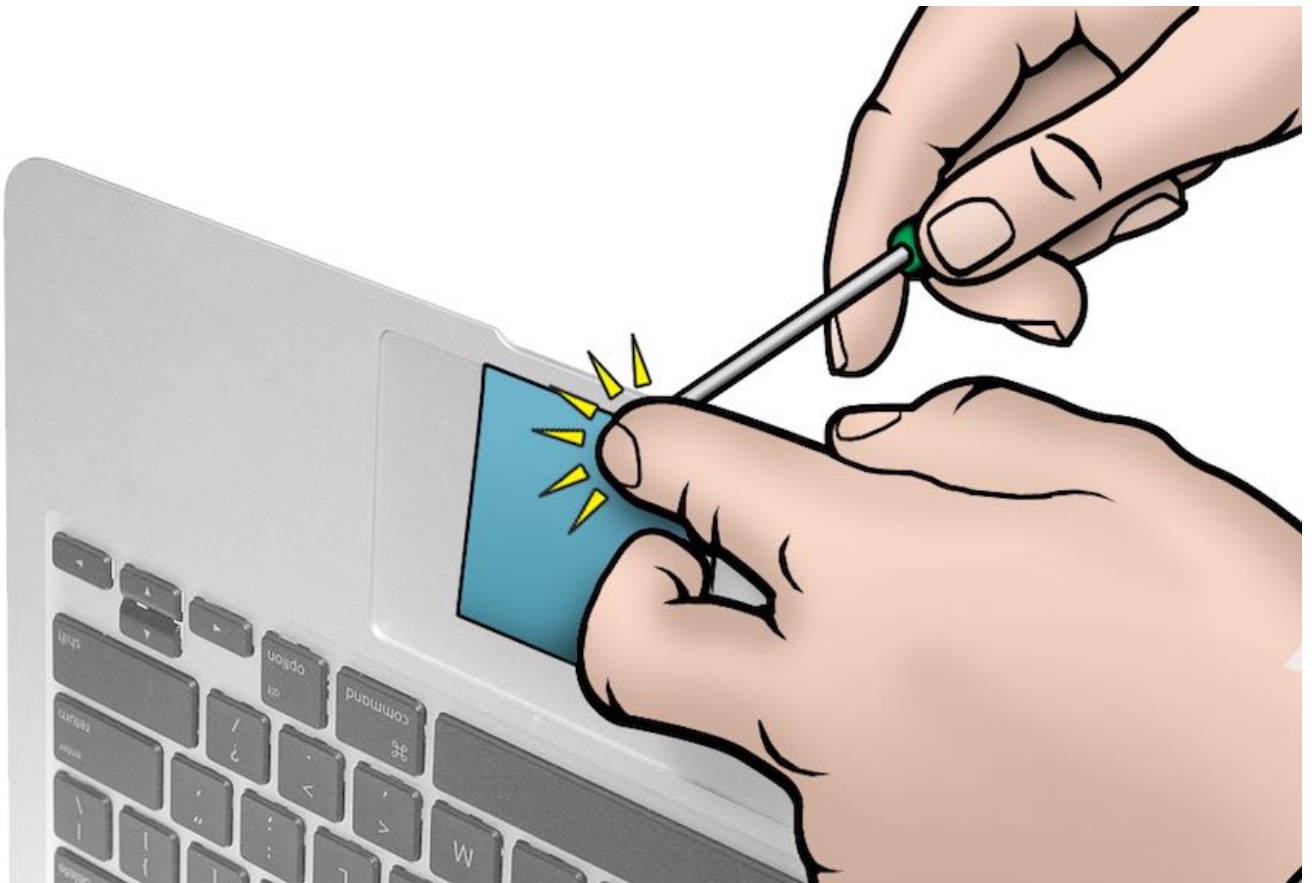
Note: Do not insert note into gap between trackpad and top case; just align edge of note with edge of trackpad.



14. With one hand on edge of sticky note and other hand slowly adjusting set screw, tighten screw just until sticky note on trackpad feels flush with top case.

Important: Overtightening set screw can damage trackpad.

15. Remove sticky note and check trackpad for normal clicking motion.



Important: After replacing a Mid 2013, Early 2014, Early 2015, or 2017 trackpad, you must use Trackpad Keyboard Mapper to ensure the trackpad is coded to match keyboard version.

- For Mid 2013 and Early 2014 models, refer to article [TP1016: AST Reference Guide: Using the Trackpad Keyboard Mapper](#).
- For Early 2015 and 2017 models, use the Trackpad Keyboard Mapper in AST 2. For more information about AST 2, refer to article [TP1105: AST 2 for Mac Reference Guide](#).

If the trackpad is replaced and not programmed using the Trackpad Keyboard Mapper tool:

- Only basic or generic keyboard functionality may be available
- The keyboard may not operate correctly
- The keyboard backlight function keys may not control the keyboard backlight brightness

Display Clamshell

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to article [SV166: Display Assembly Replacement Video](#) (Mid 2012 to 2017).

Remove:

- [Bottom Case](#)

For MacBook Air (13-inch, Mid 2013) and later models, also remove:

- [I/O Flex Cable](#)
- [Fan](#)



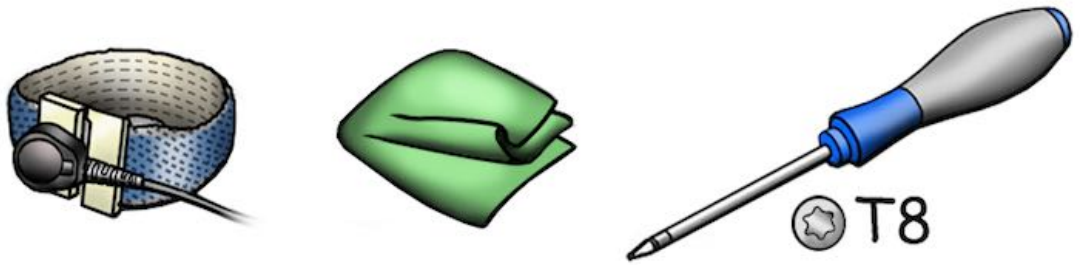
Important: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board.

Caution: Read [Battery Safety Precautions](#) before performing this procedure.



Tools

- ESD wrist strap
- Clean, soft, lint-free cloth
- Torx T8 screwdriver (magnetized)



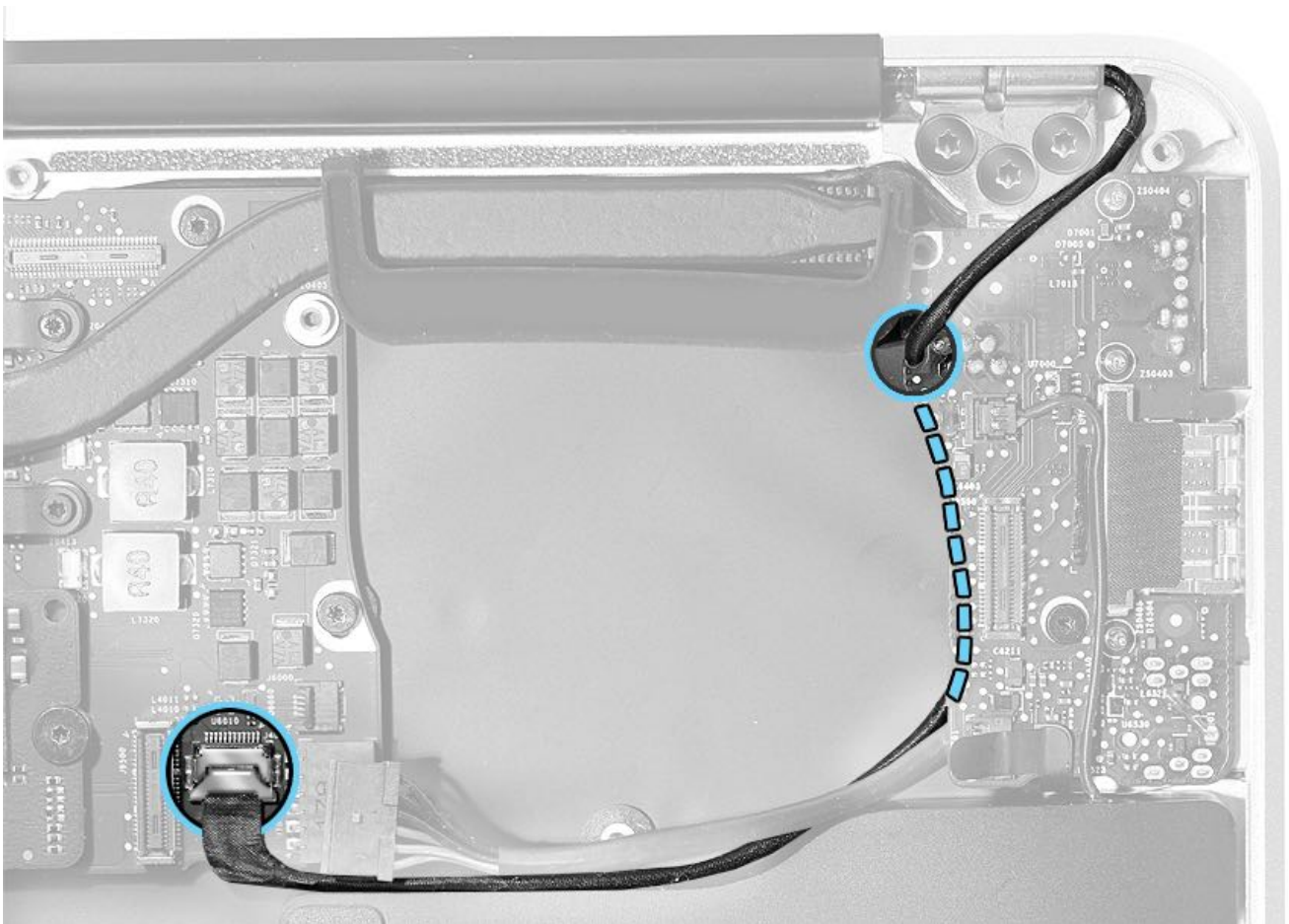
Steps For Removal

1. Place display clamshell (open to 90 degrees) so it safely hangs over a clean, padded table edge.

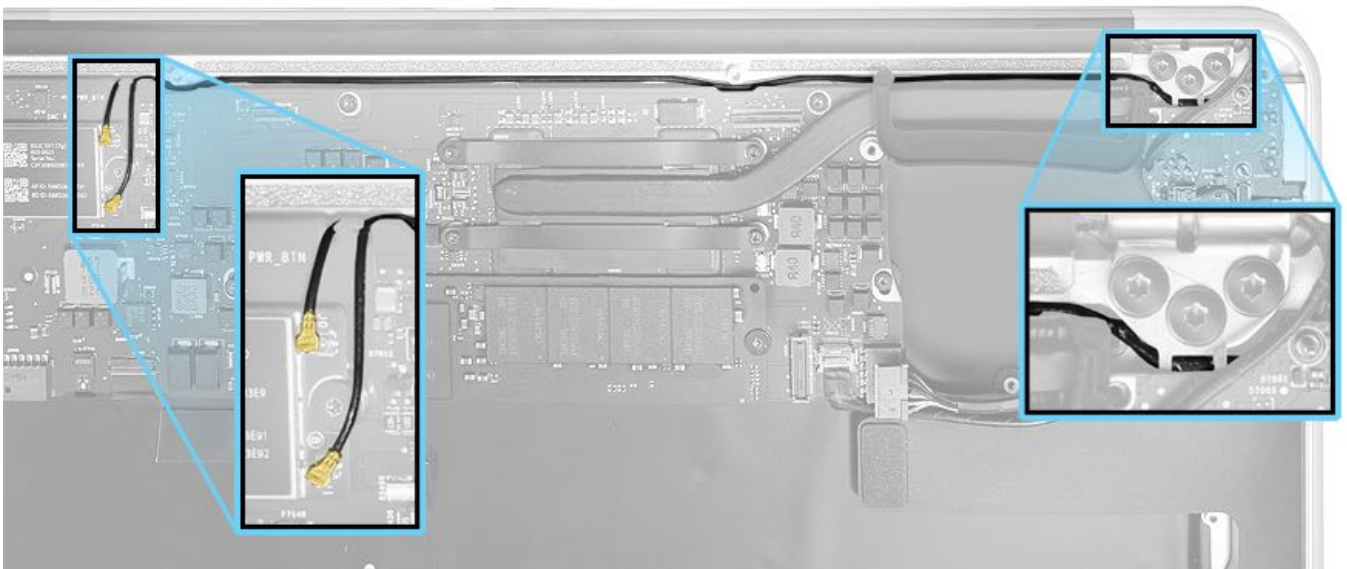


2. Disconnect display cable from logic board.

- Gently flip up lock bar to unlock connector (1).
- Use black stick or fingernail to disconnect display cable (2).



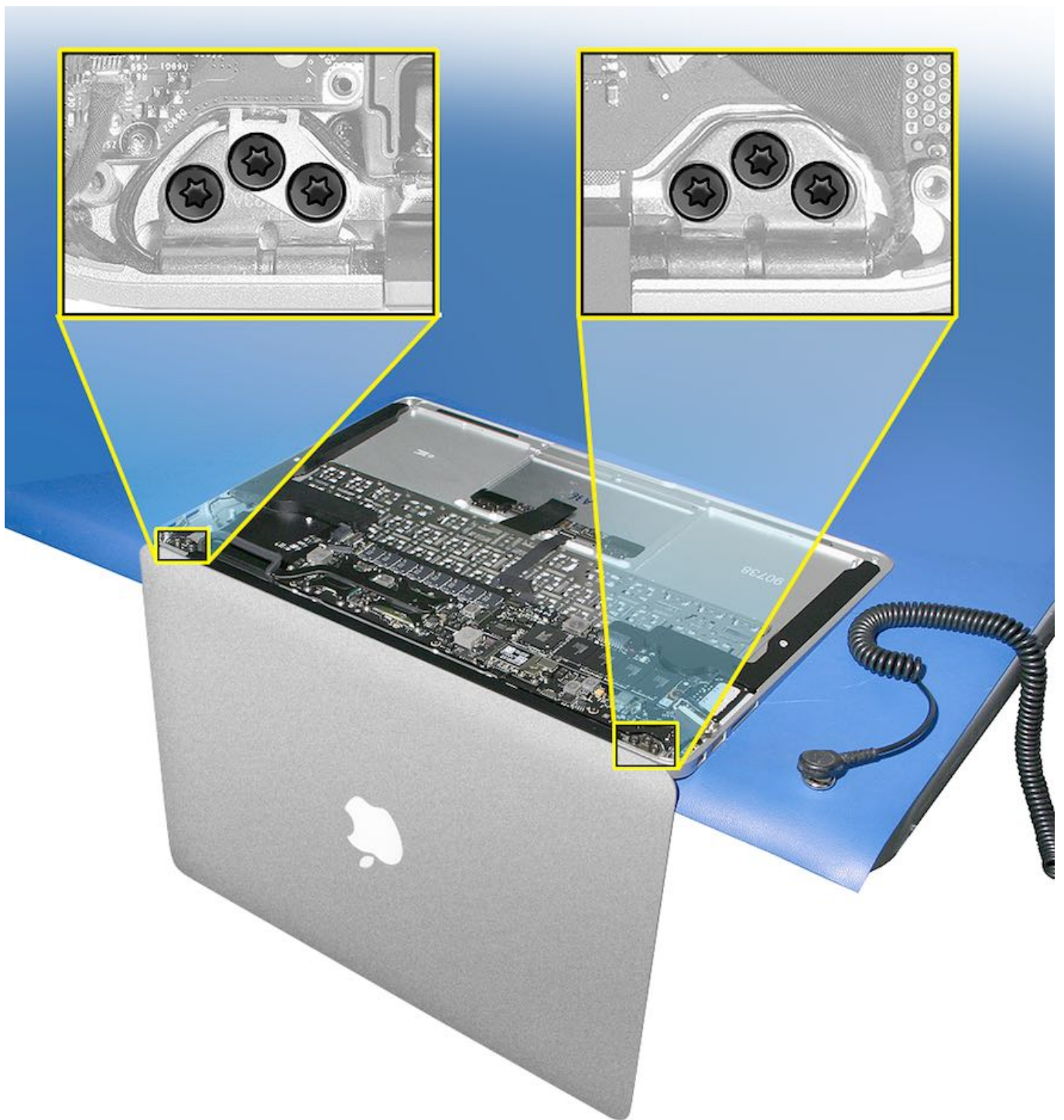
4. Disconnect antennas from wireless card, remove antennas from notches in logic board, and gently pry antenna cable from channel on top case. Take note of cable routing around top right corner of fan and display hinge.



5. Remove six Torx T8 screws (three at each clutch):

- T8: 922-9652, 4.3 mm

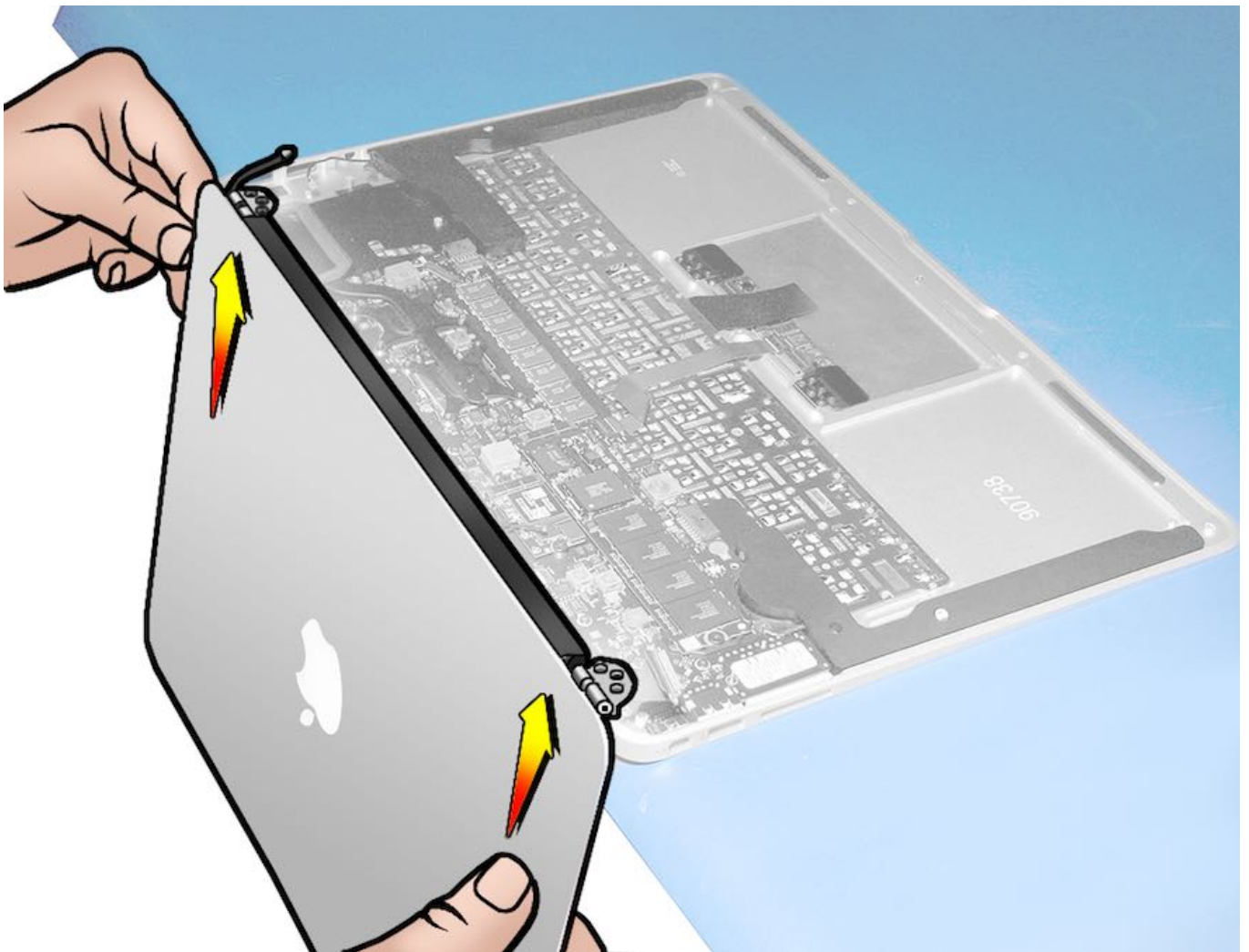




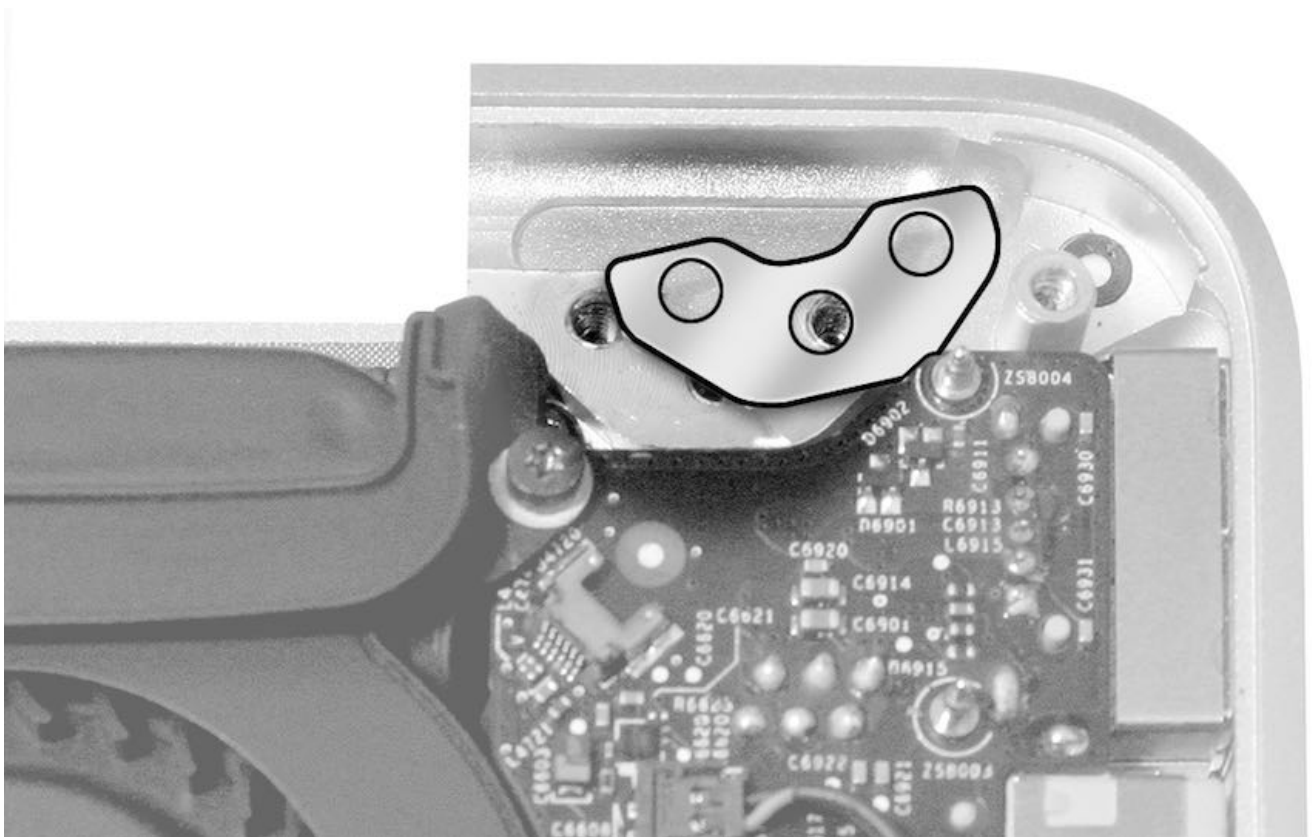
6. While supporting assembly, separate display clamshell from top case.

Late 2010, Mid 2011, and Mid 2012 models: As you lift the display clamshell, look for a metal shim under each clutch (922-9649). See next step.

Note: Mid 2013 and later models do not include clutch shims.



7. **Late 2010, Mid 2011, and Mid 2012 models:** Remove and save metal shim at each clutch.



Steps For Reassembly

Note: Steps 1–4 do not apply to Mid 2013 and later models. Skip to step 5.

1. **Late 2010, Mid 2011, and Mid 2012 models:** Place shim under clutch and align screw holes with black stick.

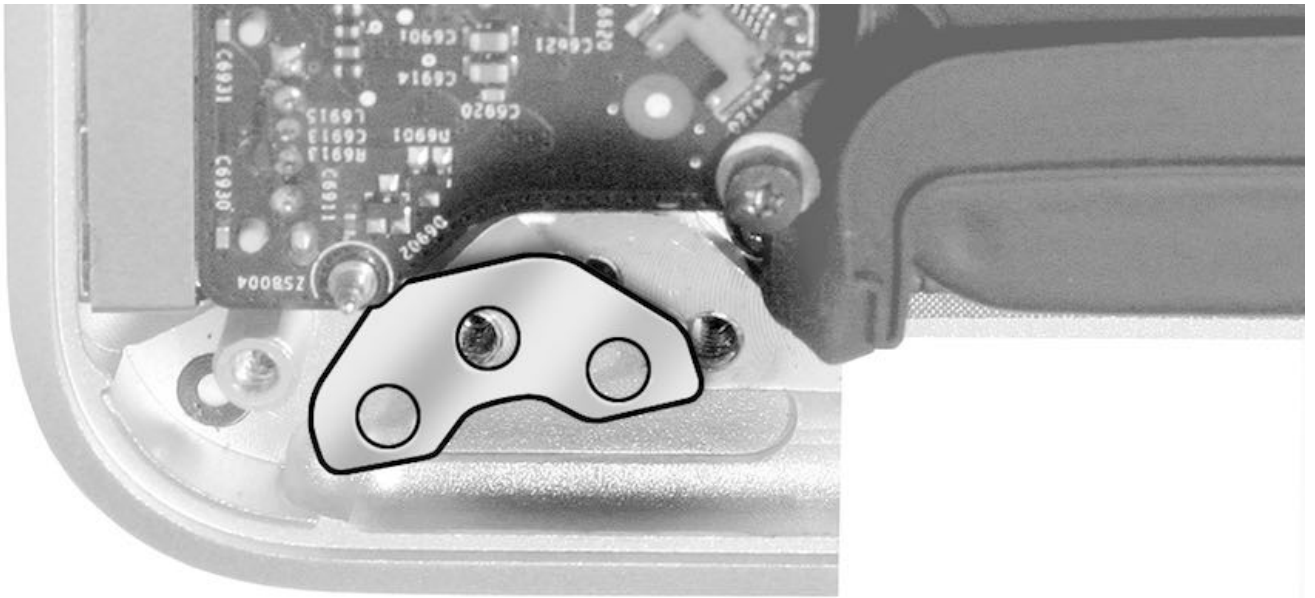


2. **Late 2010, Mid 2011, and Mid 2012 models:** Loosely install middle screw.



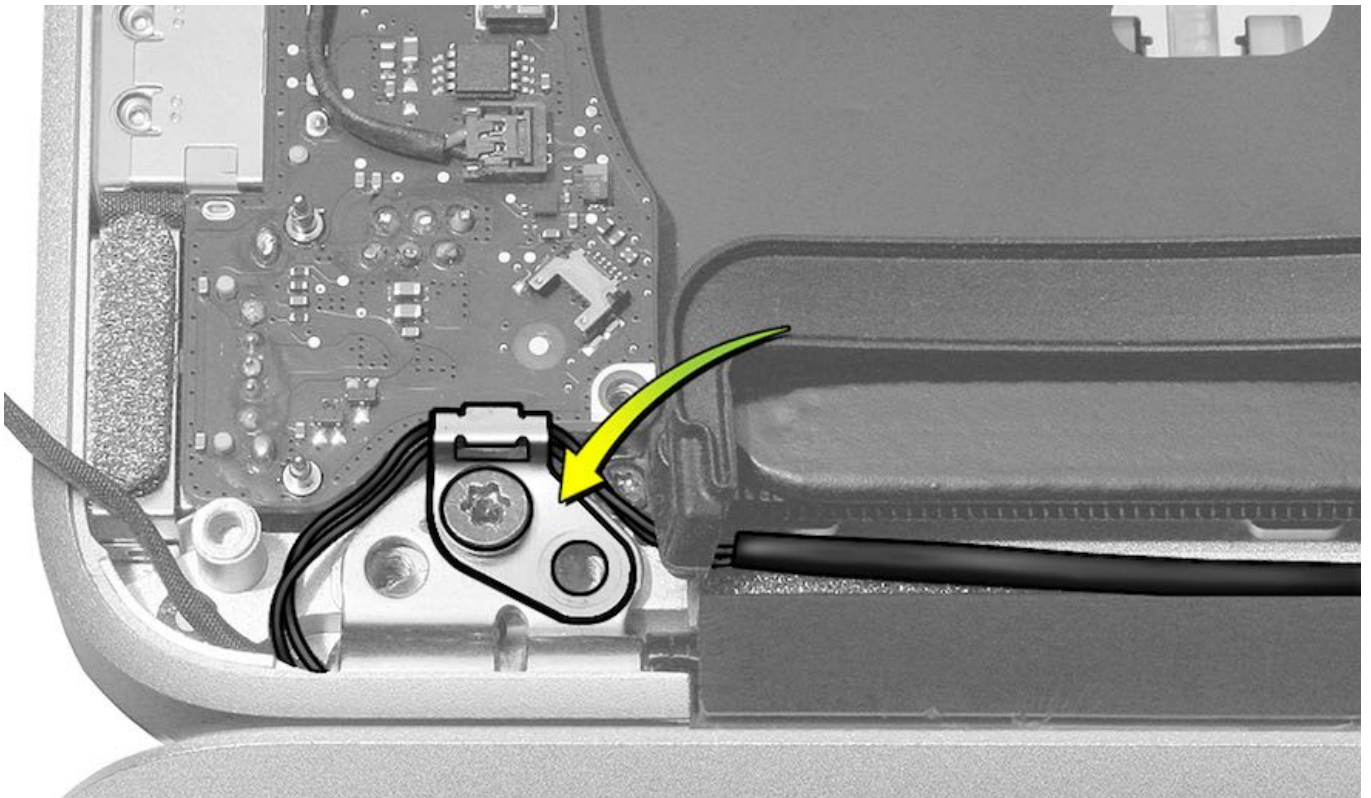
Late 2010, Mid 2011, and Mid 2012 models:

3. On the other clutch hinge, place shim onto top case. Align screw holes.
4. Place display clutch hinge on top of loose shim.

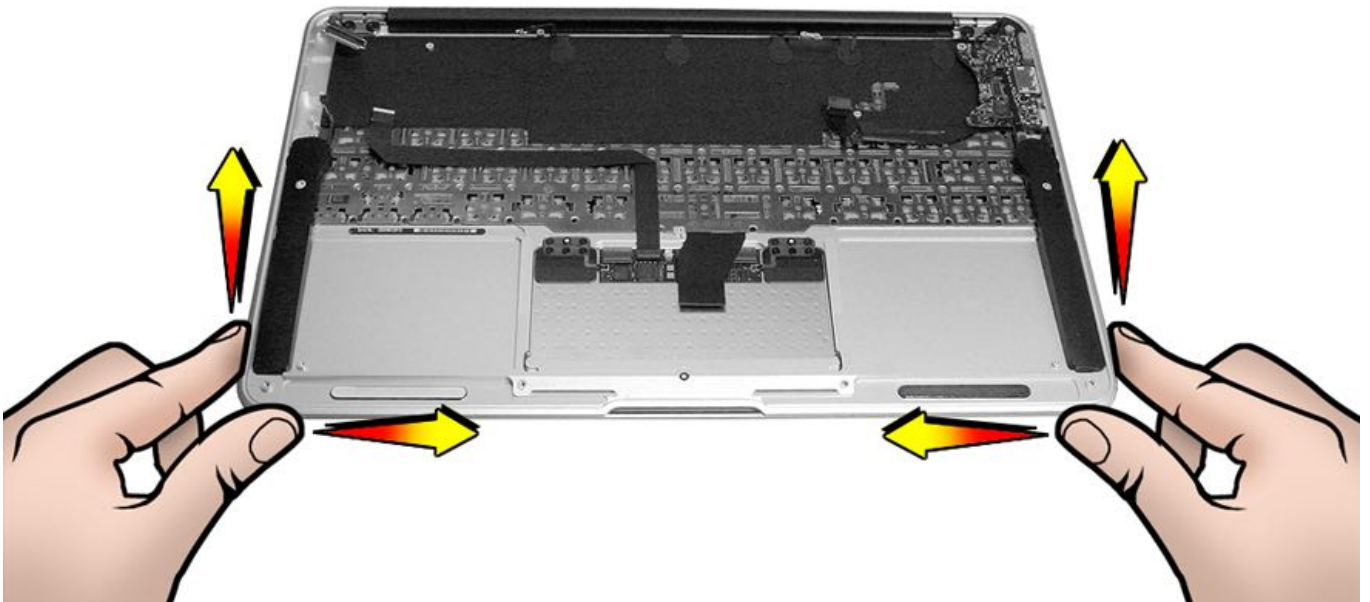


5. Place antenna ground clip on top of clutch hinge. Loosely install middle screw.

Caution: Incorrect placement of ground clip could cause cable damage.



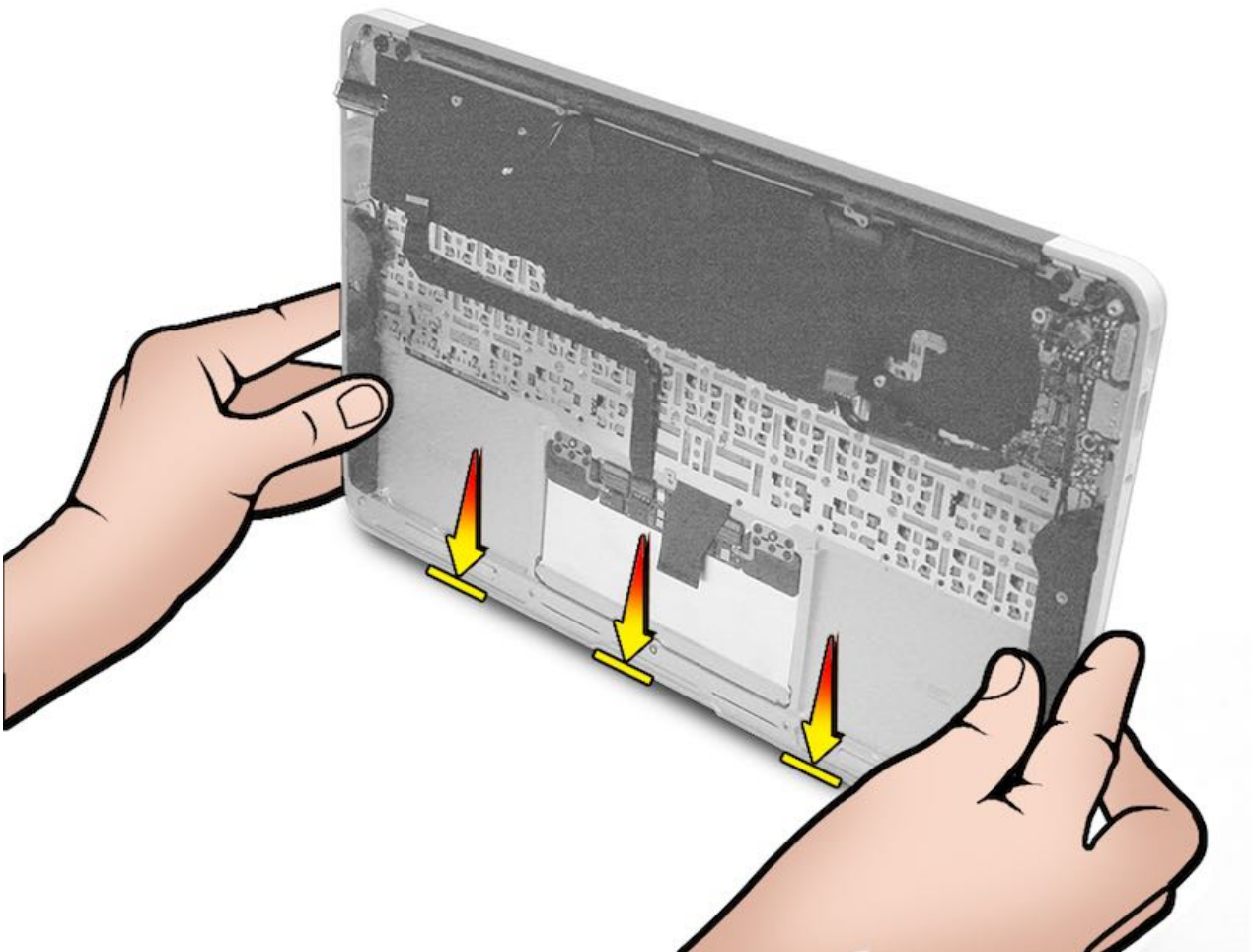
6. Adjust case alignment by touch.



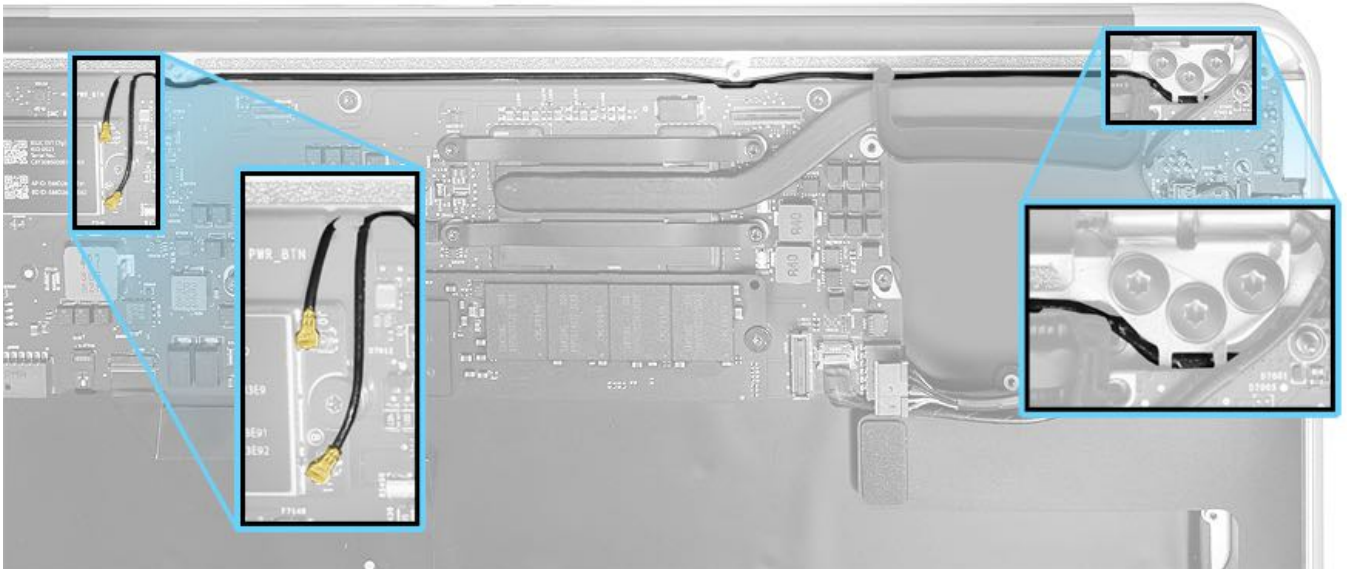
7. Stand the computer on a clean, flat surface to level front-to-rear clutch alignment.

8. Tighten six Torx T8 screws (three at each clutch):

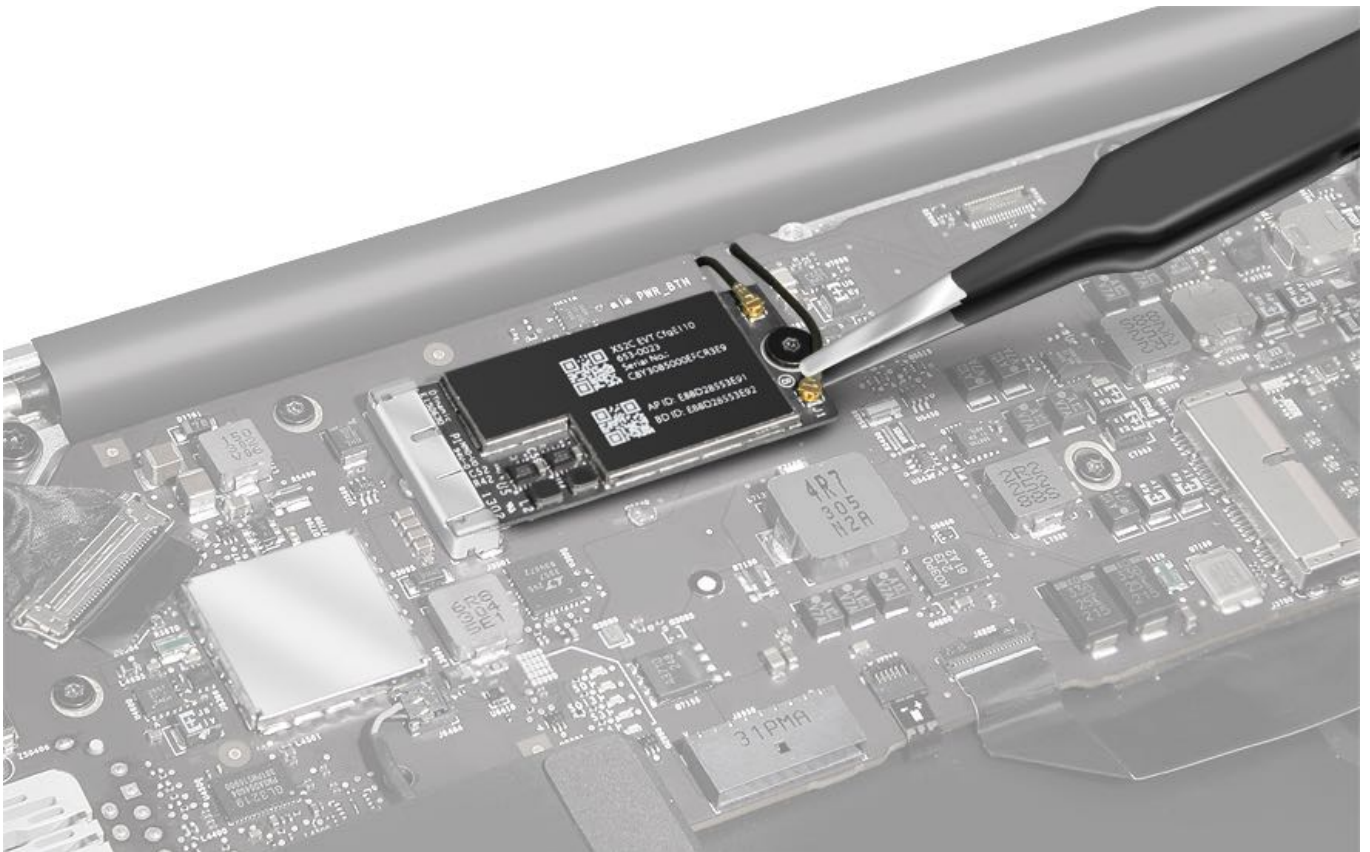
- T8: 922-9652, 4.3 mm



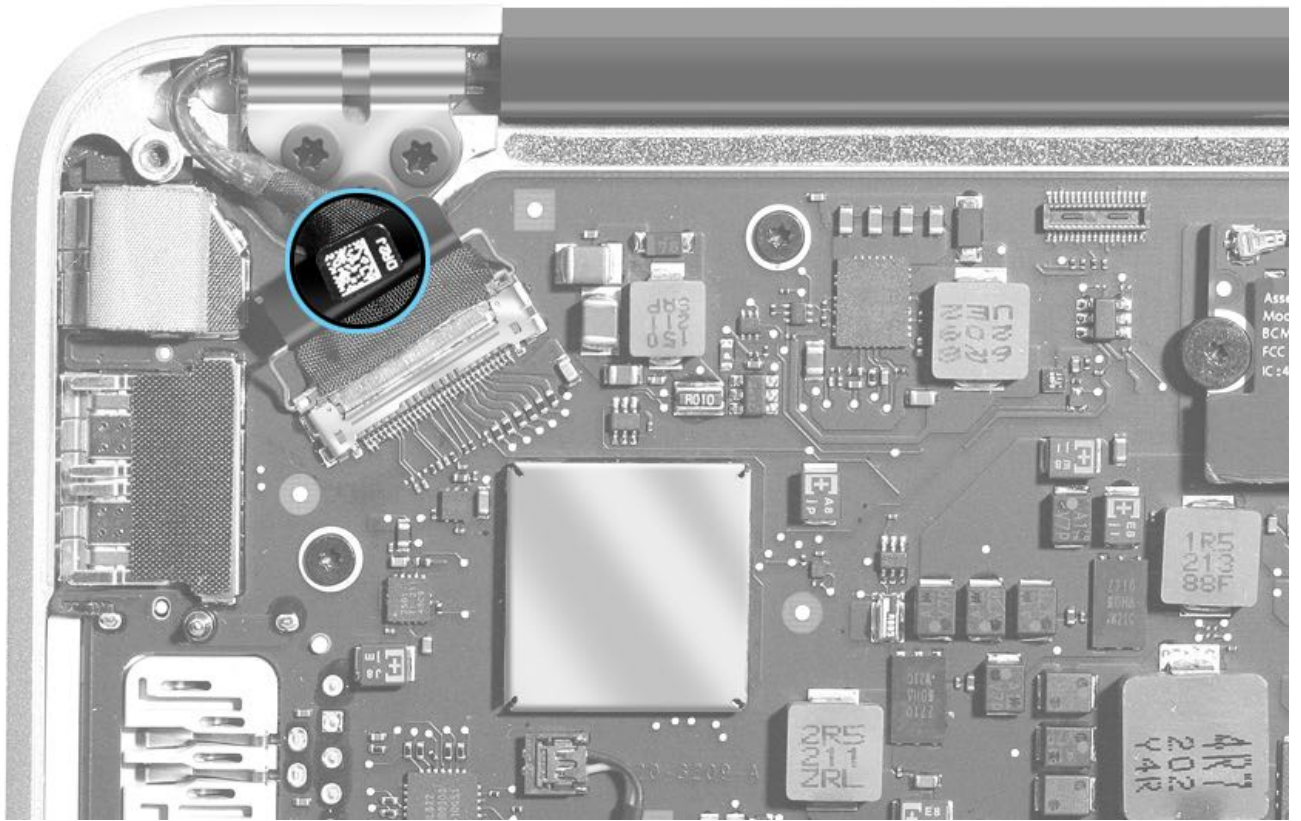
9. Route antenna cable into channel on top case. Continue routing antenna to the left, tucking it into channel.



10. Connect antennas to AirPort/Bluetooth or wireless card.



Note: Mid 2012 and later models include a 2D bar code of the display clamshell serial number on the underside of the pull-tab for the eDP cable. The bar code links the display clamshell to the system serial number.



Display Clutch Cover

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to article [SV167: Display Clutch Replacement Video](#) (Mid 2012 to 2017).

Remove:

- [Bottom Case](#)
- [Display Clamshell](#)

For MacBook Air (13-inch, Mid 2013) and later models, also remove:

- [I/O Flex Cable](#)
- [Fan](#)



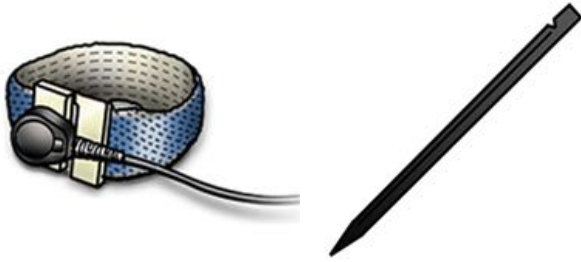
Important: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board.

Caution: Read [Battery Safety Precautions](#) before performing this procedure.



Tools

- ESD wrist strap
- Black stick
- Clean, soft, lint-free cloth (not shown)
- Clutch cover kit that includes left/right adhesive strips (not shown)

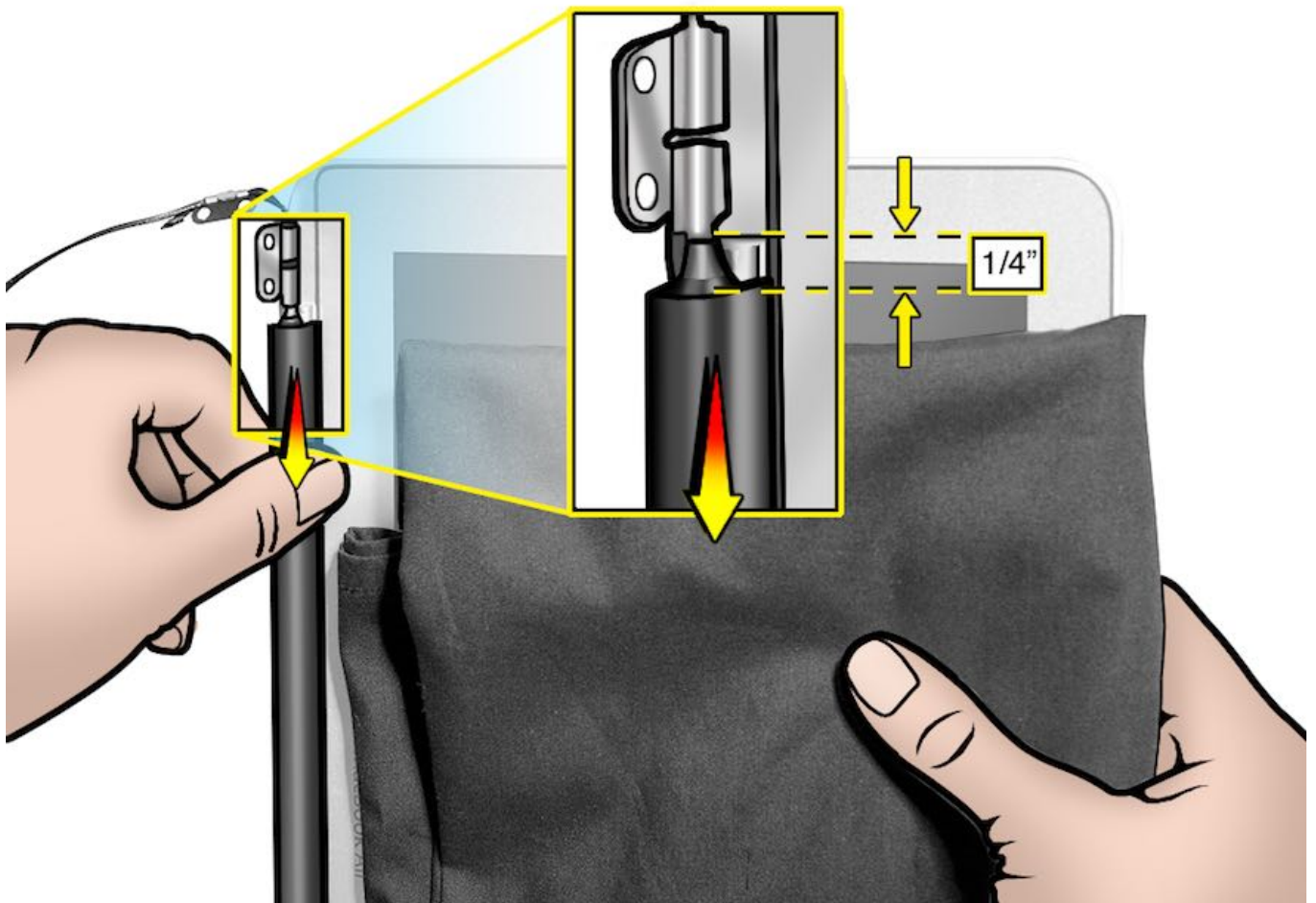


Steps For Removal

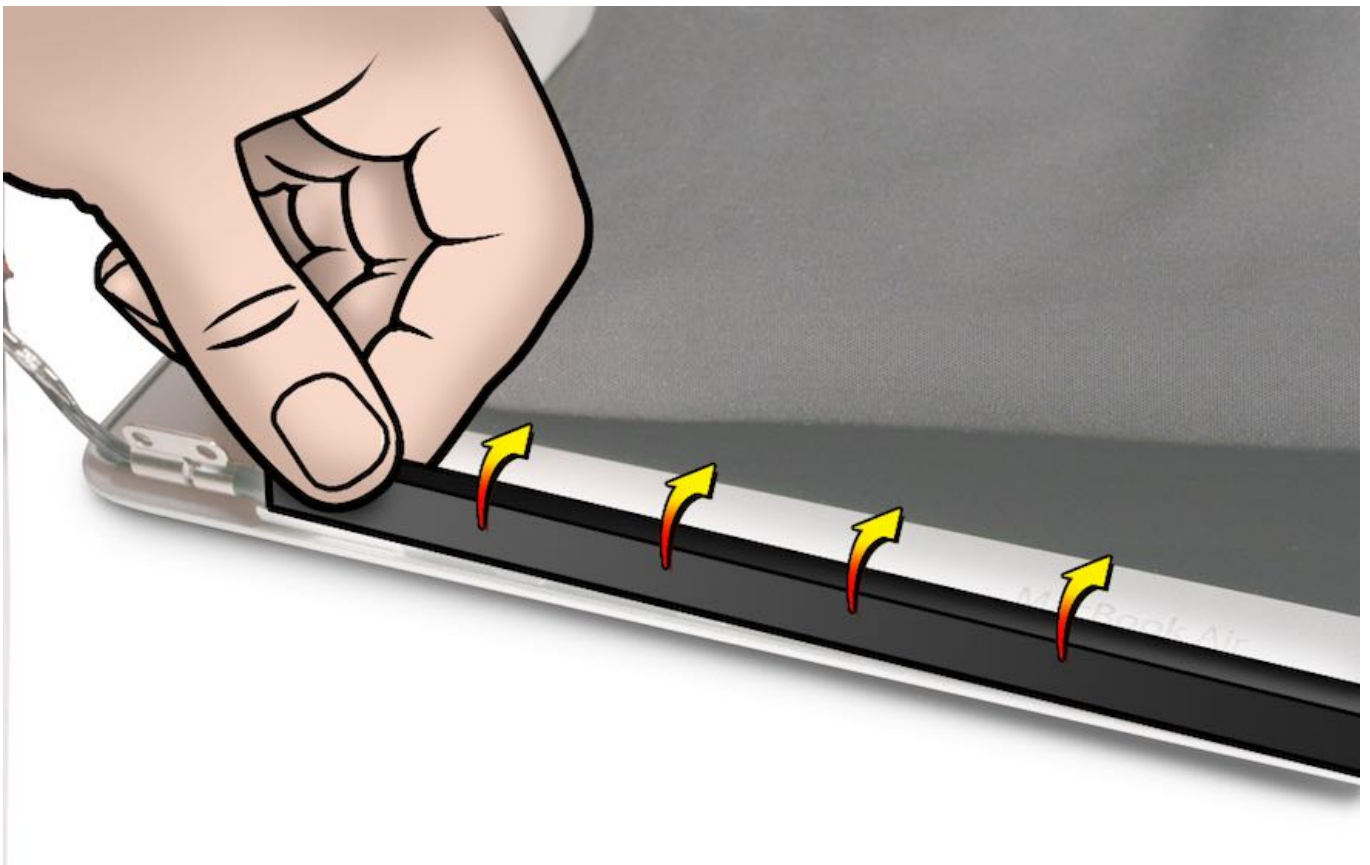
Note: Although this procedure shows some MacBook Air (11-inch, Late 2010) images, the steps are the same for the MacBook Air (13-inch, Mid 2011) and later models.

1. Cover display face with clean, soft cloth and hold display vertically.
2. Slide clutch cover 0.25 inch (6.35 mm) away from camera cable.

Note: If the clutch resists movement, insert a black stick in the crease to loosen any adhesive on the end of the clutch.

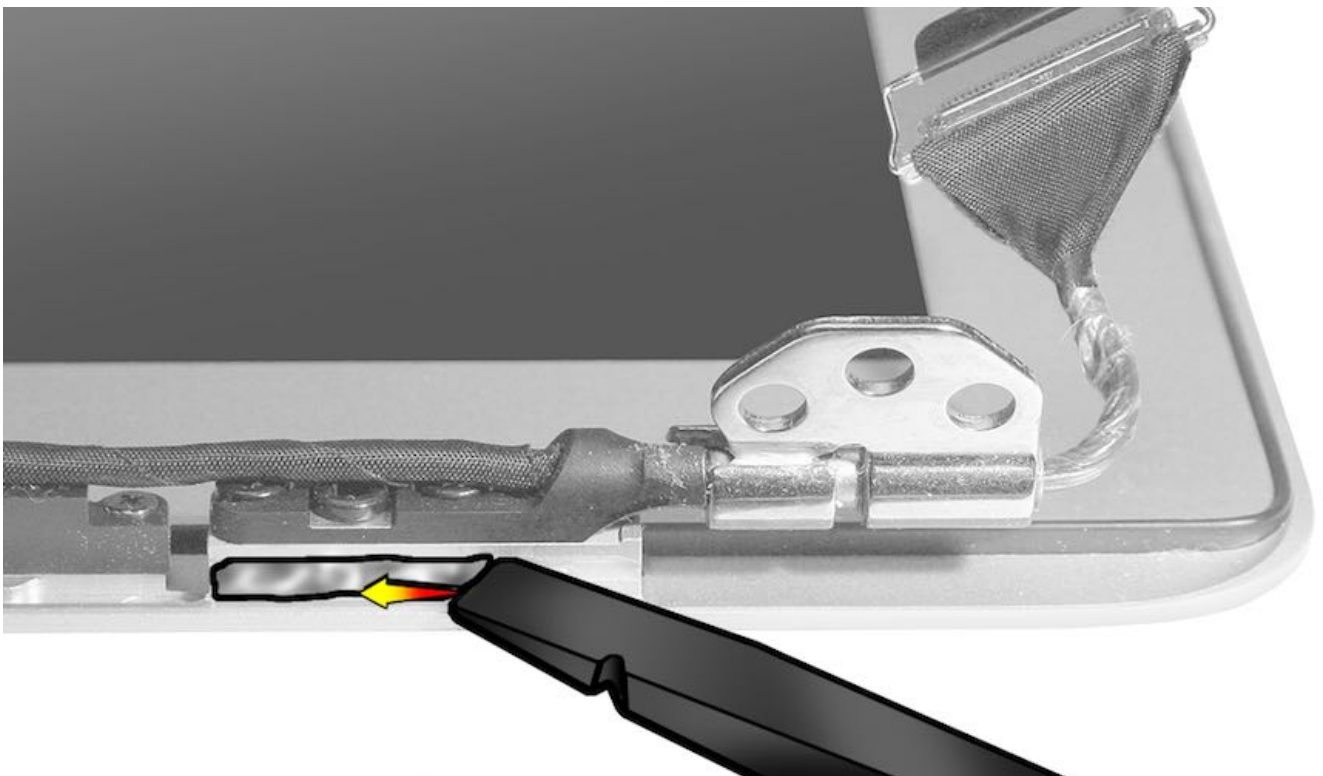


3. Place display clamshell on table.
4. Pinch and tilt up end of clutch cover as you roll it toward display face. Use a black stick to assist in the clutch cover removal.
5. Remove clutch cover.

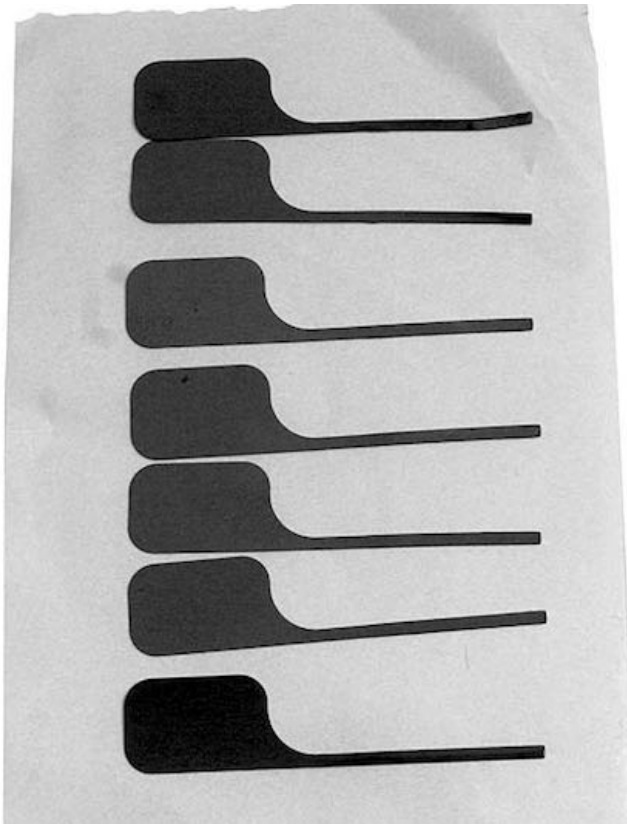


Steps For Reassembly

1. Clean residual VHB (very high bond) adhesive from both ends of display housing.

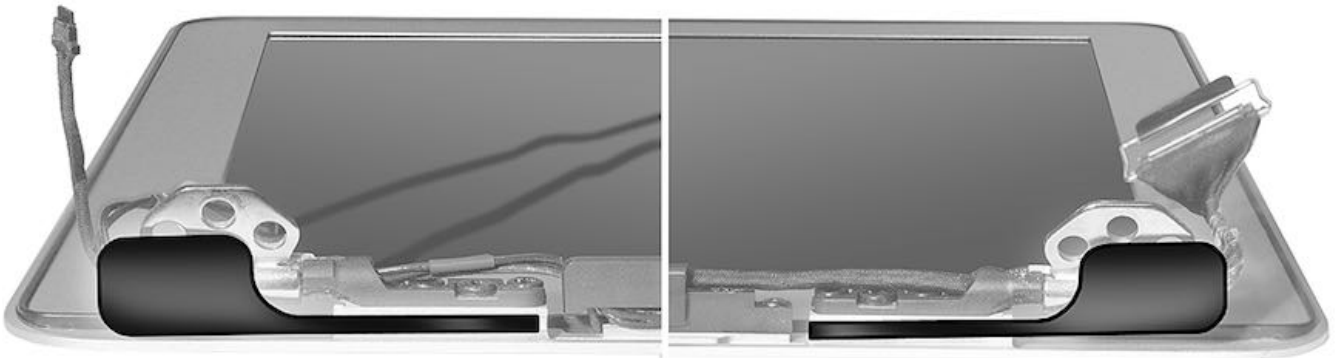


2. Notice the right and left VHB strips. You will use one VHB strip for each display hinge.



3. Apply one VHB strip to each hinge mount.

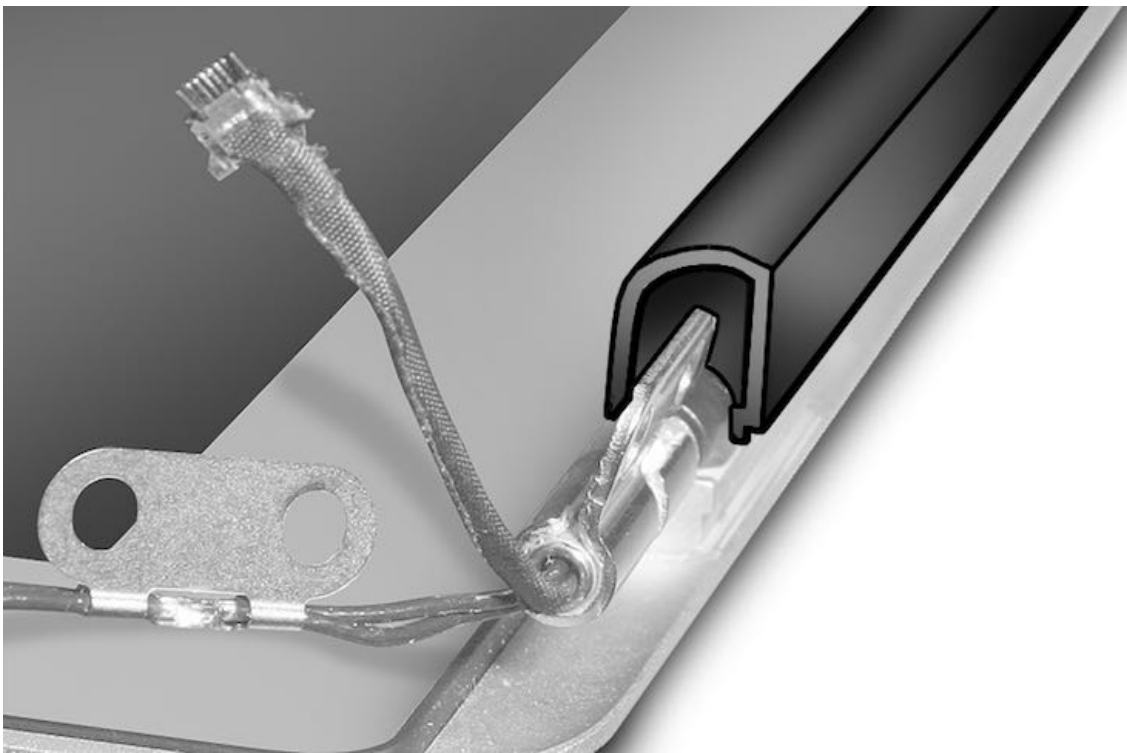
4. Keep the strips in place as you install the clutch cover.



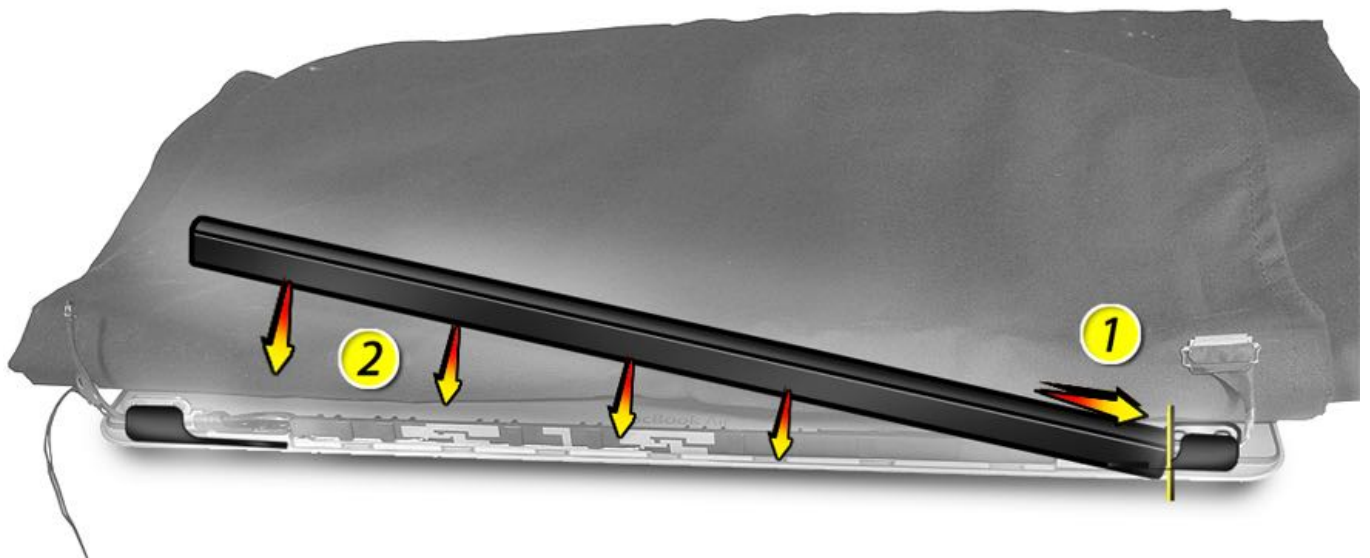
5. Note shape of clutch cover:

- Flat at bottom
- Curved at top

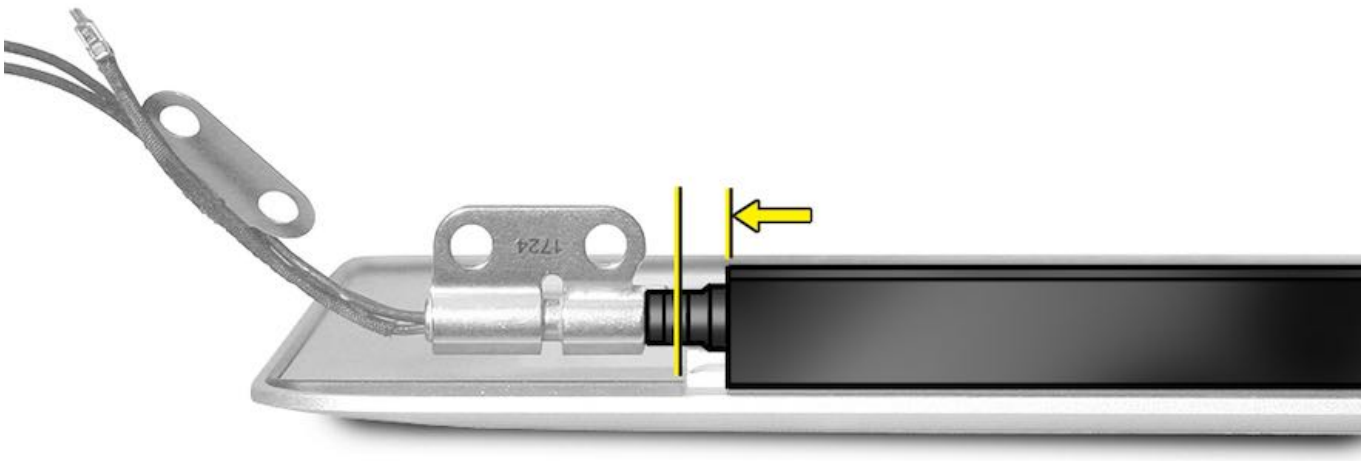
6. Make sure flat edge is at bottom of display.



7. Tilt clutch cover over right hinge mount.
8. Lower clutch cover onto display clamshell.
9. Listen for snapping sound as hooks engage.



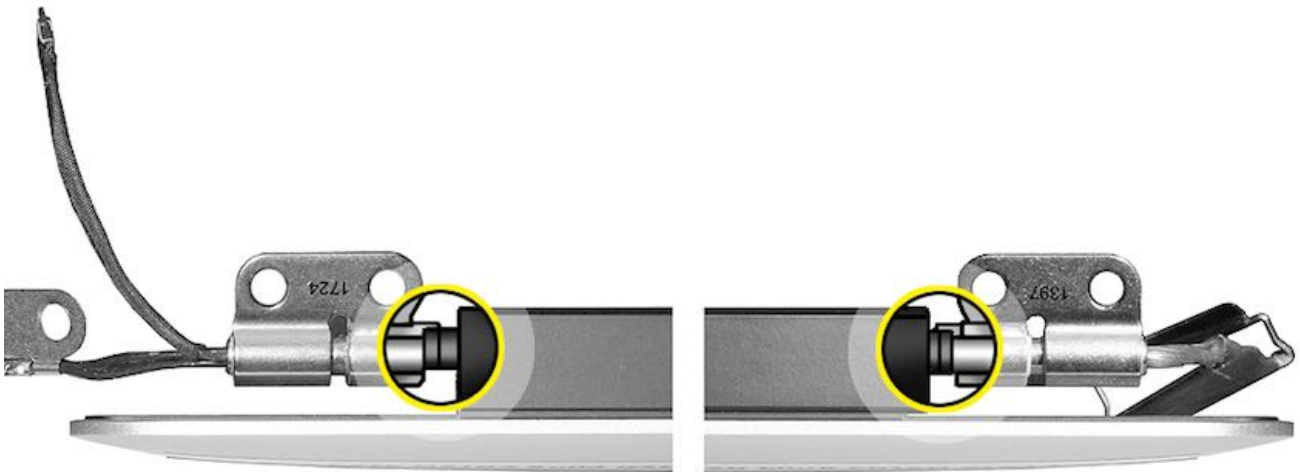
10. With the clutch cover engaged, slide it to the left to close the gap.
(VHB strip not shown.)



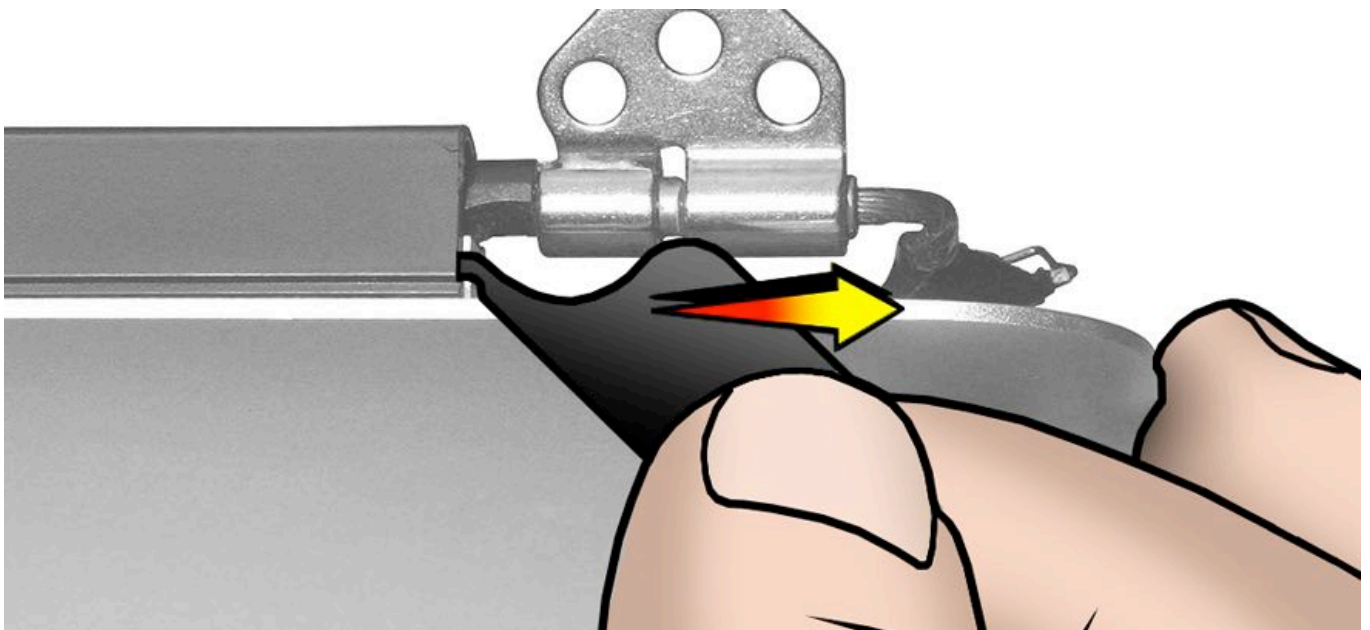
11. Check for good fit at both ends and across the clutch cover. Avoid:

- Gaps
- Bulges
- Pinched cables

(VHB strips not shown.)



12. With clutch cover fully installed, pull exposed tab on each side to remove VHB strips.



Top Case with Keyboard

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).

For video instruction, refer to articles:

- [SV168: Top Case Replacement Video](#) (Mid 2012 to 2017)
- [SV164: Microphone Replacement Video](#) (Mid 2012)

Remove and transfer:

- [Bottom Case](#)
- [Battery](#)
- [Right Speaker](#) (Late 2010)
- [Right Speaker](#) (Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017)
- [Left Speaker](#)
- [SSD Card](#) (Late 2010)
- [SSD Card or Flash Storage](#) (Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017)
- [I/O Flex Cable](#)
- [Fan](#)
- [Display Clamshell](#)
- [I/O Board](#) (Late 2010, Mid 2011, Mid 2012)
- [I/O Board](#) (Mid 2013, Early 2014, Early 2015, 2017)
- [IPD Flex Cable](#) (Late 2010)
- [IPD Flex Cable](#) (Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017)
- [Logic Board](#) (with heat sink and AirPort/Bluetooth or wireless card attached for Late 2010, Mid 2011, Mid 2012)
- [Logic Board](#) (with heat sink and wireless card attached for Mid 2013, Early 2014, Early 2015, 2017)
- [Trackpad](#)



Important: Immediately after removing the bottom case, always attach the battery cover and disconnect the battery cable from the logic board.

Caution: Read [Battery Safety Precautions](#) before performing this procedure.



Tools

- Heat gun
- Knife
- Fine-tip permanent marker



Steps For Removal

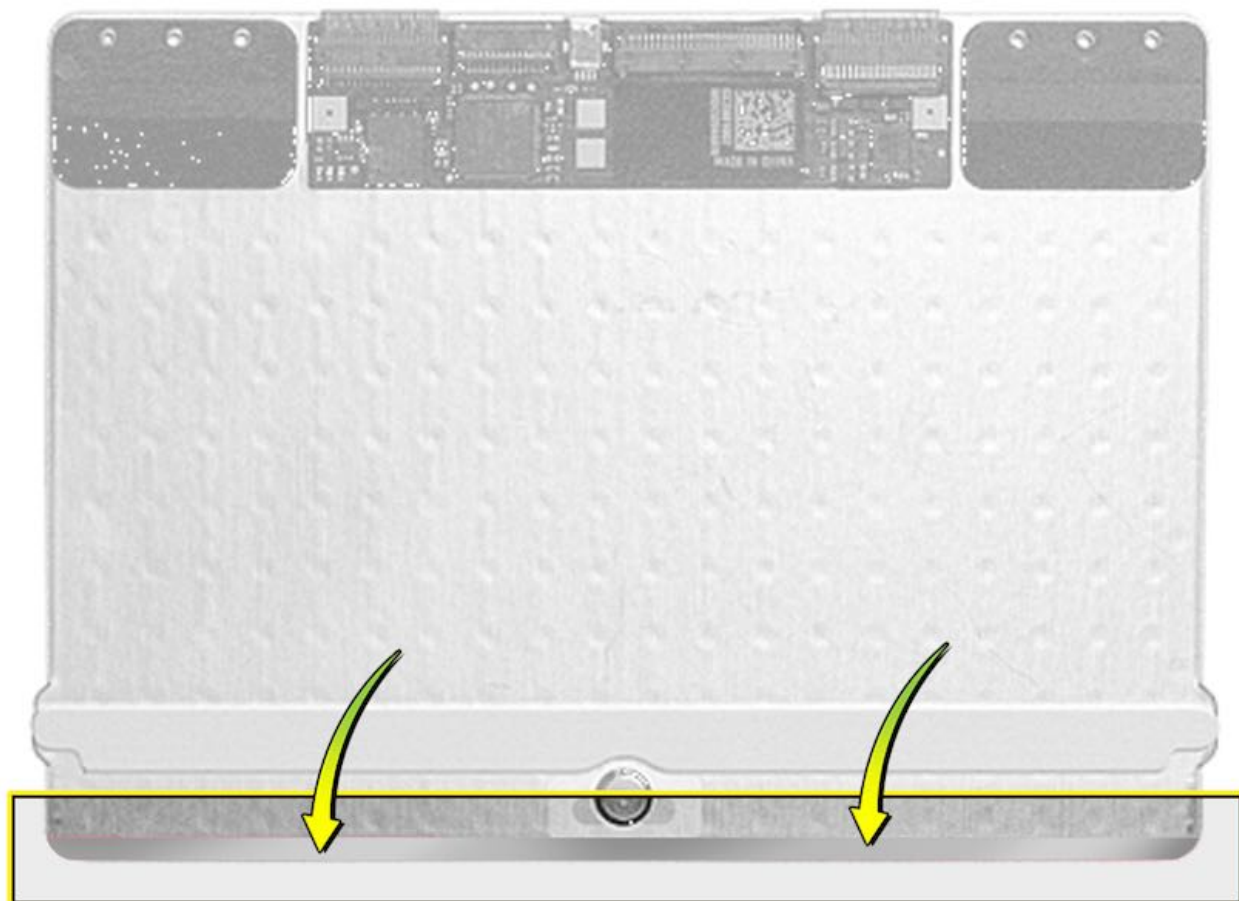
With the first steps completed, the top case is the remaining part. It includes the microphone.



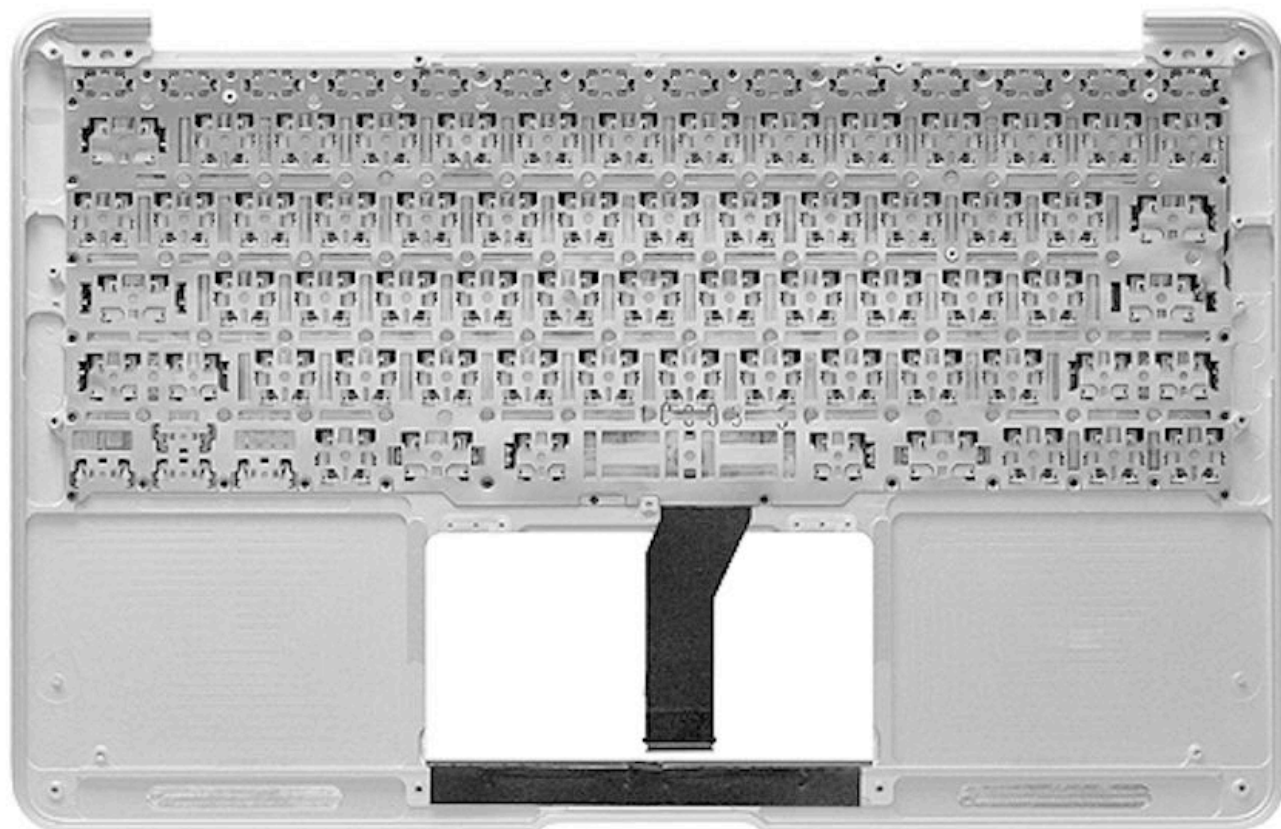
Steps For Reassembly



Caution: Be careful not to scratch exposed silver ink on lower edge of trackpad when installing trackpad into top case. Such scratches create black spots on trackpad, which are visible to user.

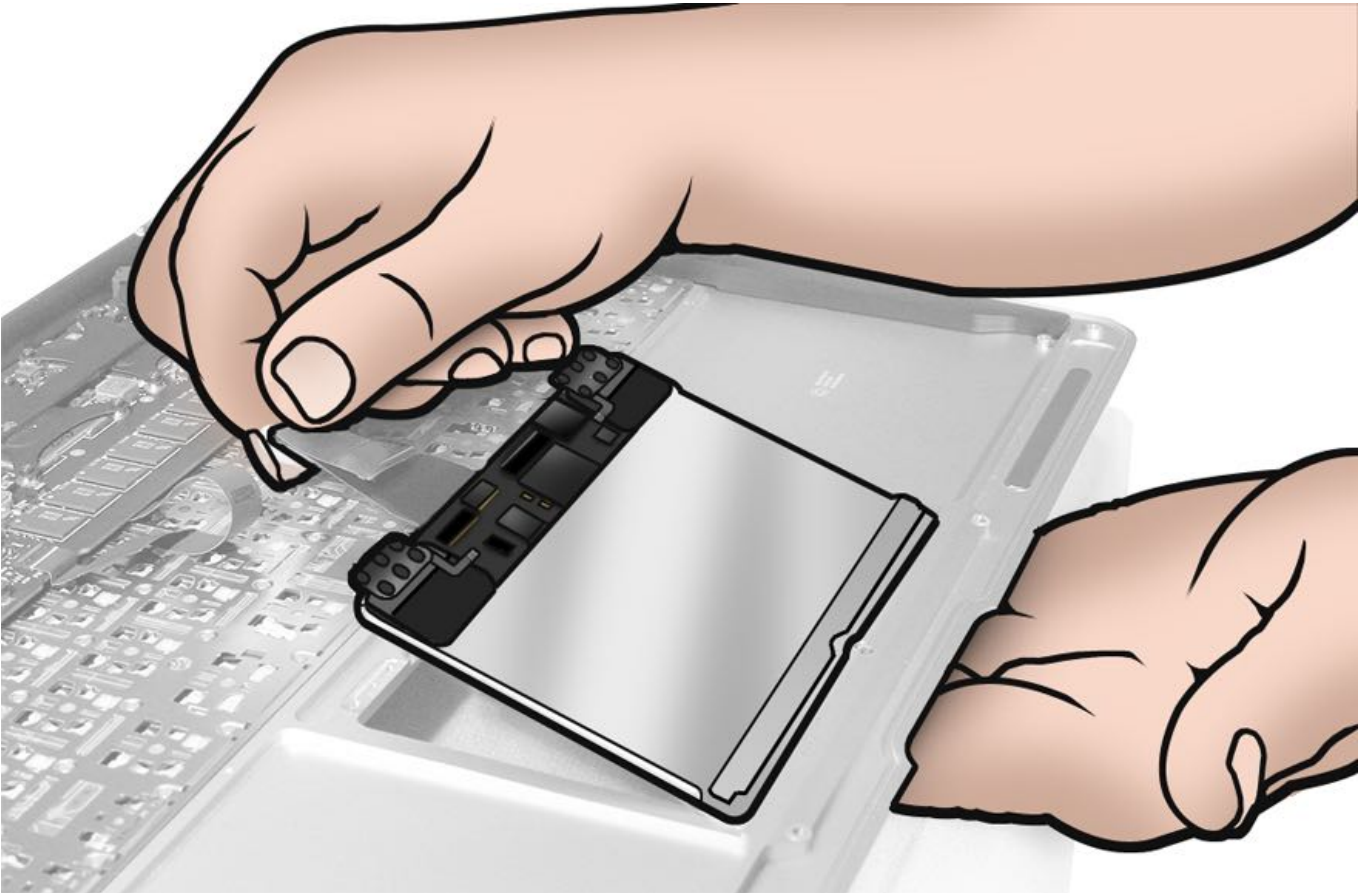


1. Replacement top case has a Mylar strip along lower edge of trackpad opening to protect exposed trackpad ink.

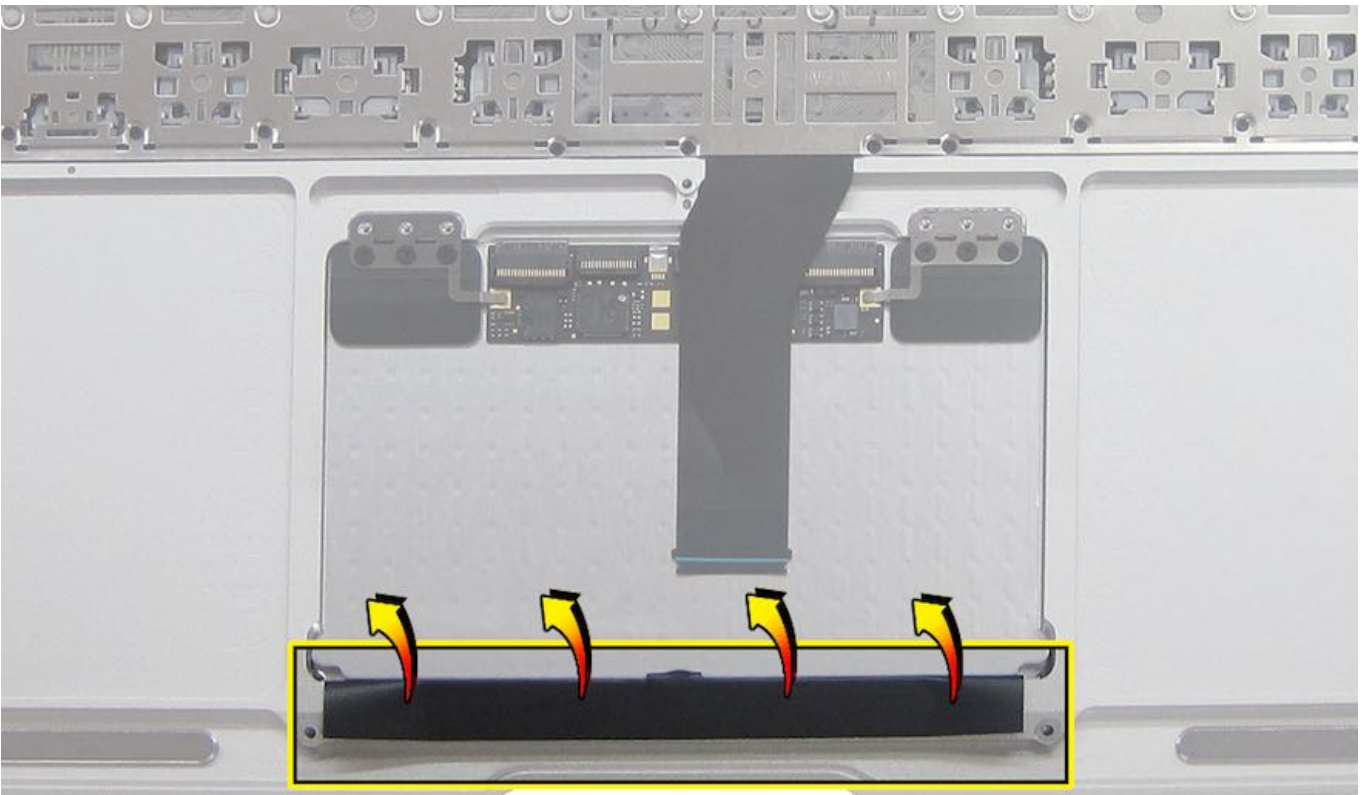


2. Carefully slide trackpad — lower edge first — into top case, until trackpad seats inside opening.

Caution: Minimize rubbing edges of trackpad against top case while installing. Friction could cause tiny cracks to form on trackpad.



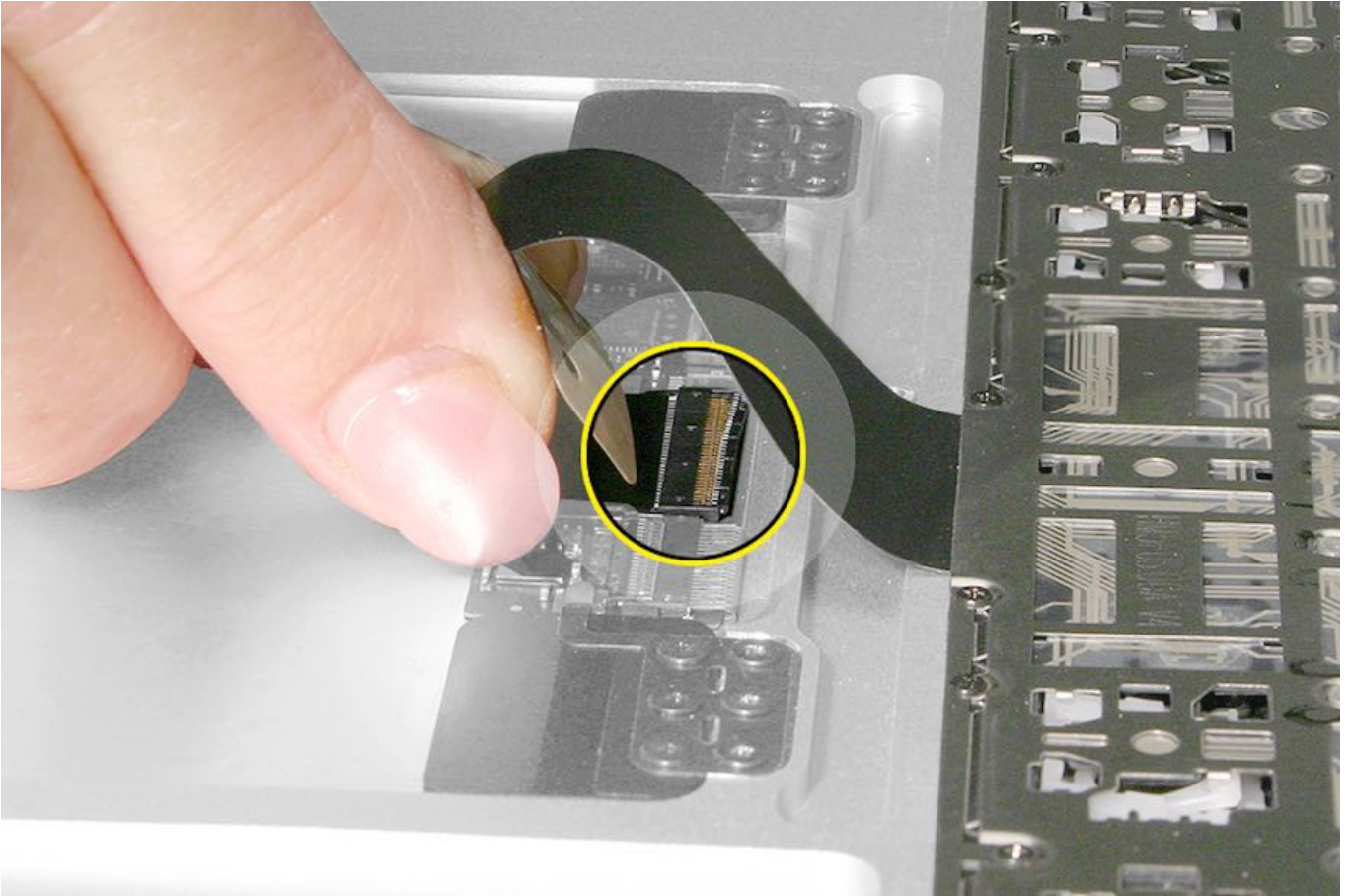
3. Remove Mylar, including any pieces that might be caught between trackpad and top case.



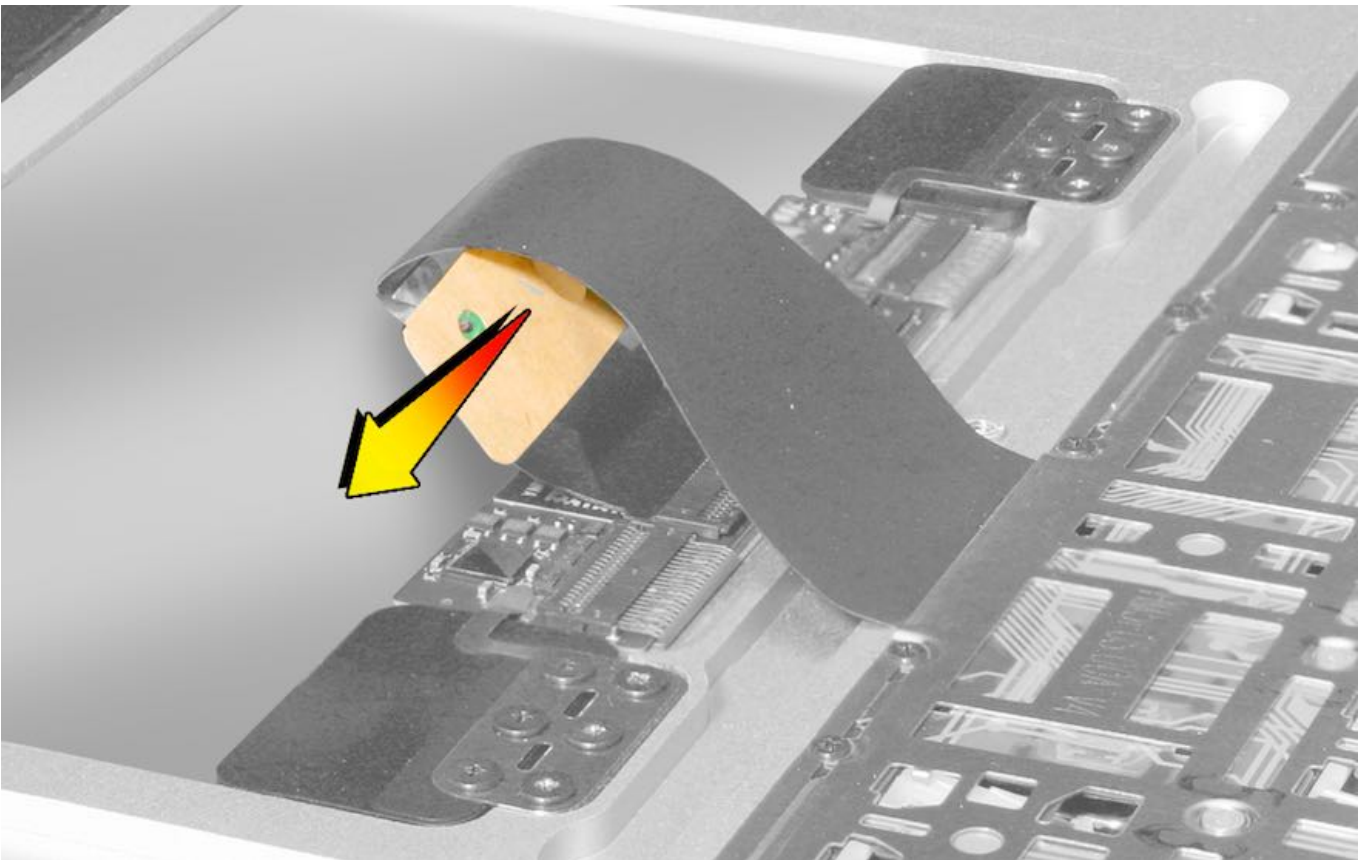
4. Insert keyboard cable into trackpad connector.

5. Flip trackpad locking lever toward logic board.

Note: If cable is already folded and sealed with very high bond (VHB) adhesive, skip steps 6 and 7.



6. Peel adhesive backing from keyboard cable to expose VHB.



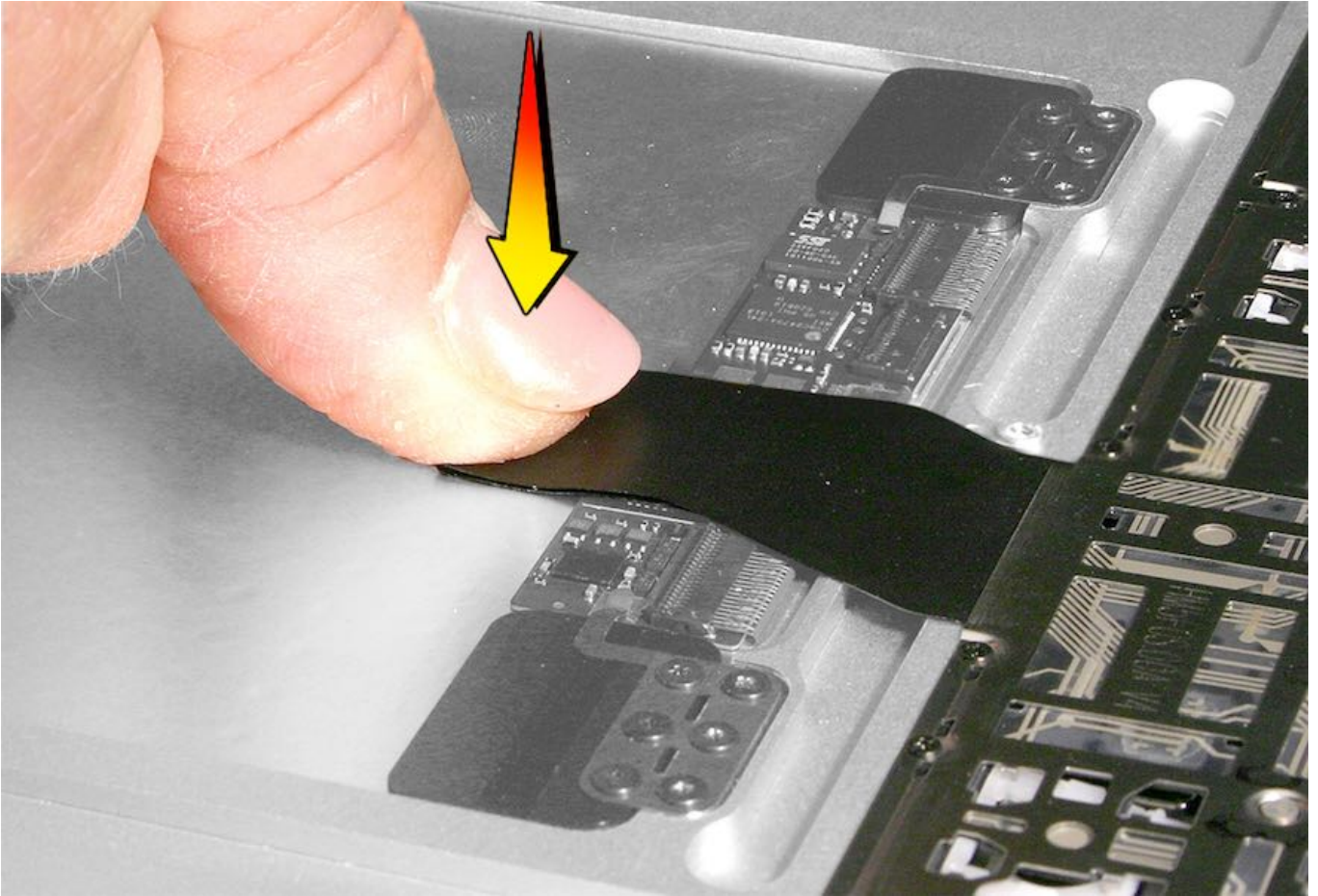
7. Press down firmly on keyboard cable for 15 seconds to:

- Flatten cable.
- Adhere VHB to upper and lower surfaces of cable.

Caution: Keyboard cable MUST lie flat against trackpad. VHB adhesive holds the bend in cable. If VHB or cable are

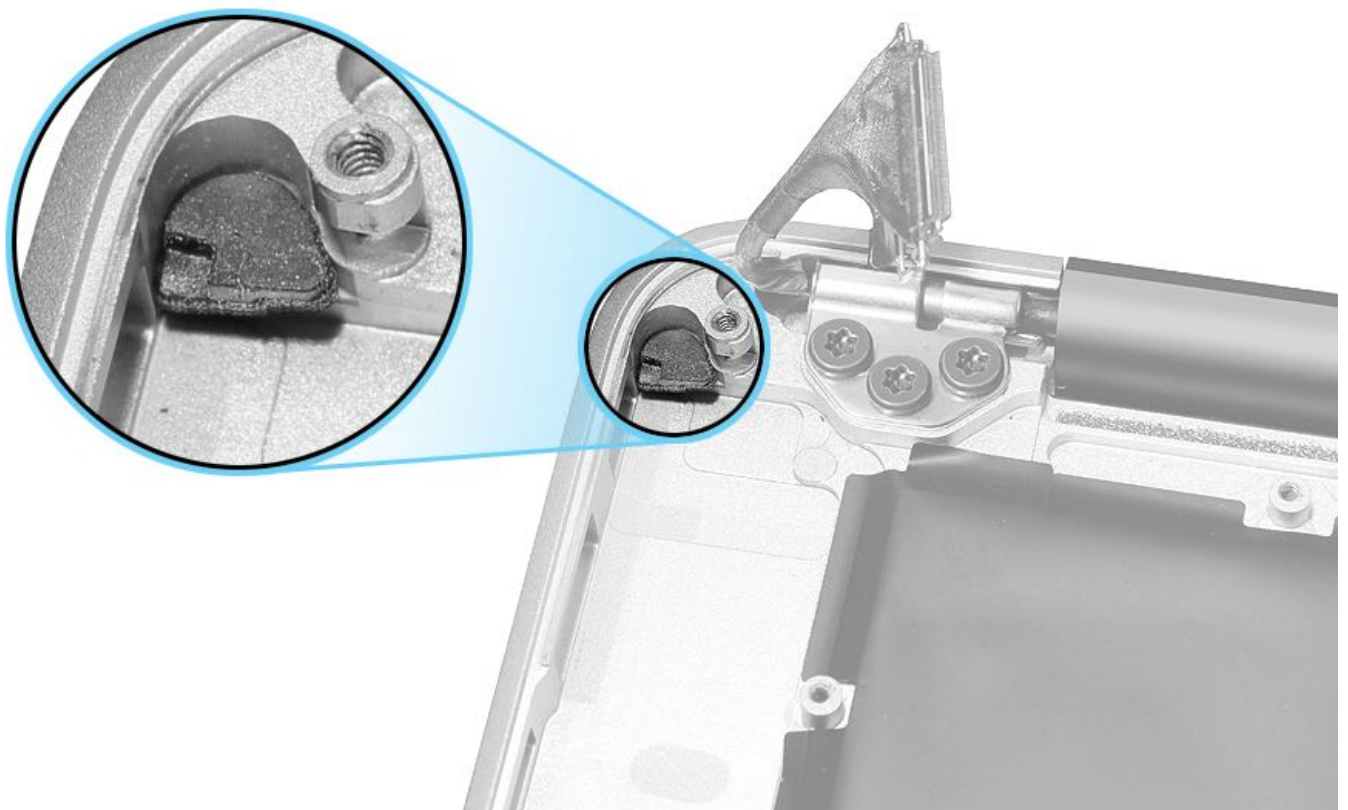
compromised, trackpad alignment issues might occur. This may necessitate top case replacement.

8. Replace trackpad screws. Connect input cable. Align trackpad.



9. **For Mid 2012 and later models:** Peel protective film from adhesive on underside of rubber gasket included with top case. Install in position shown.

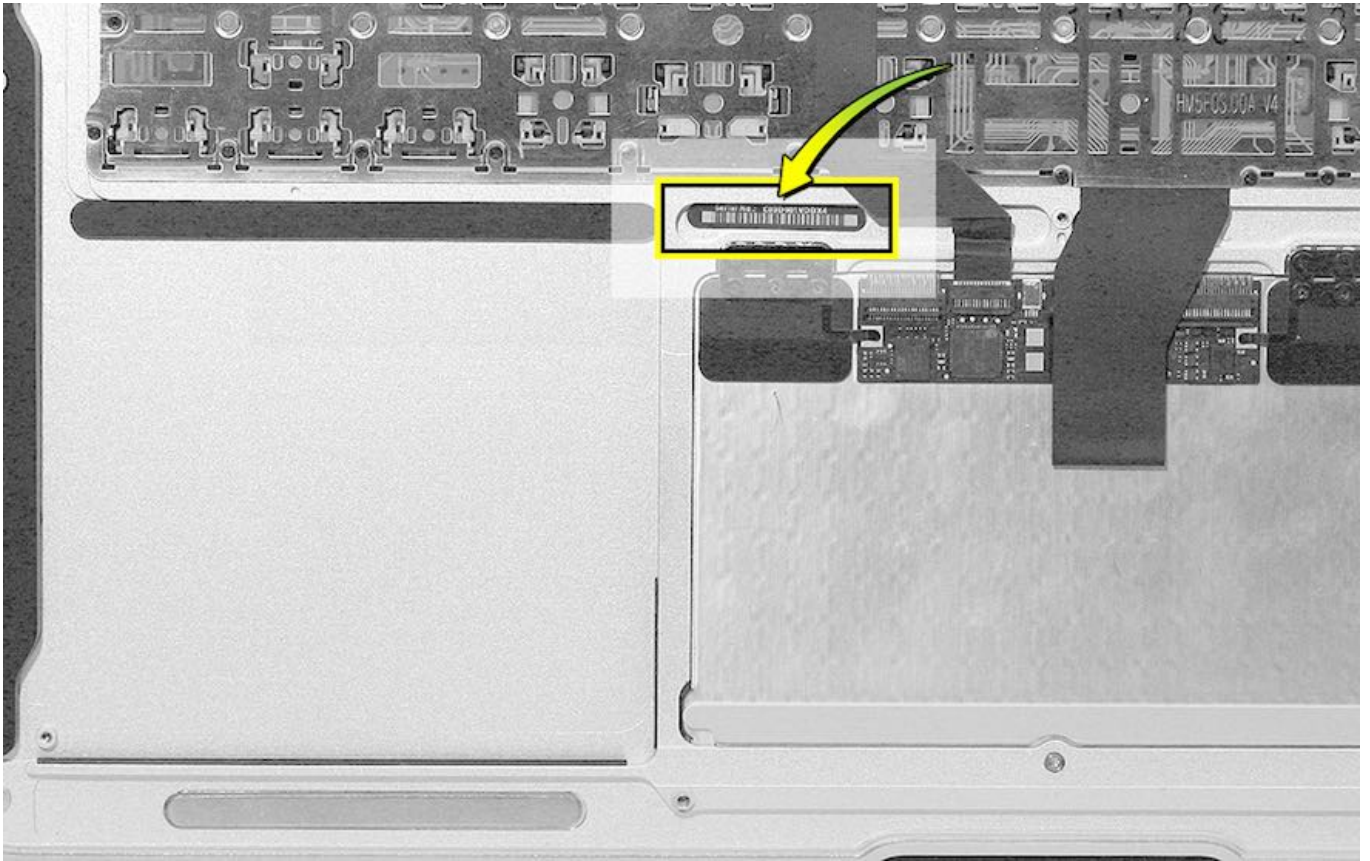
Note: Rubber gasket cannot be ordered separately.



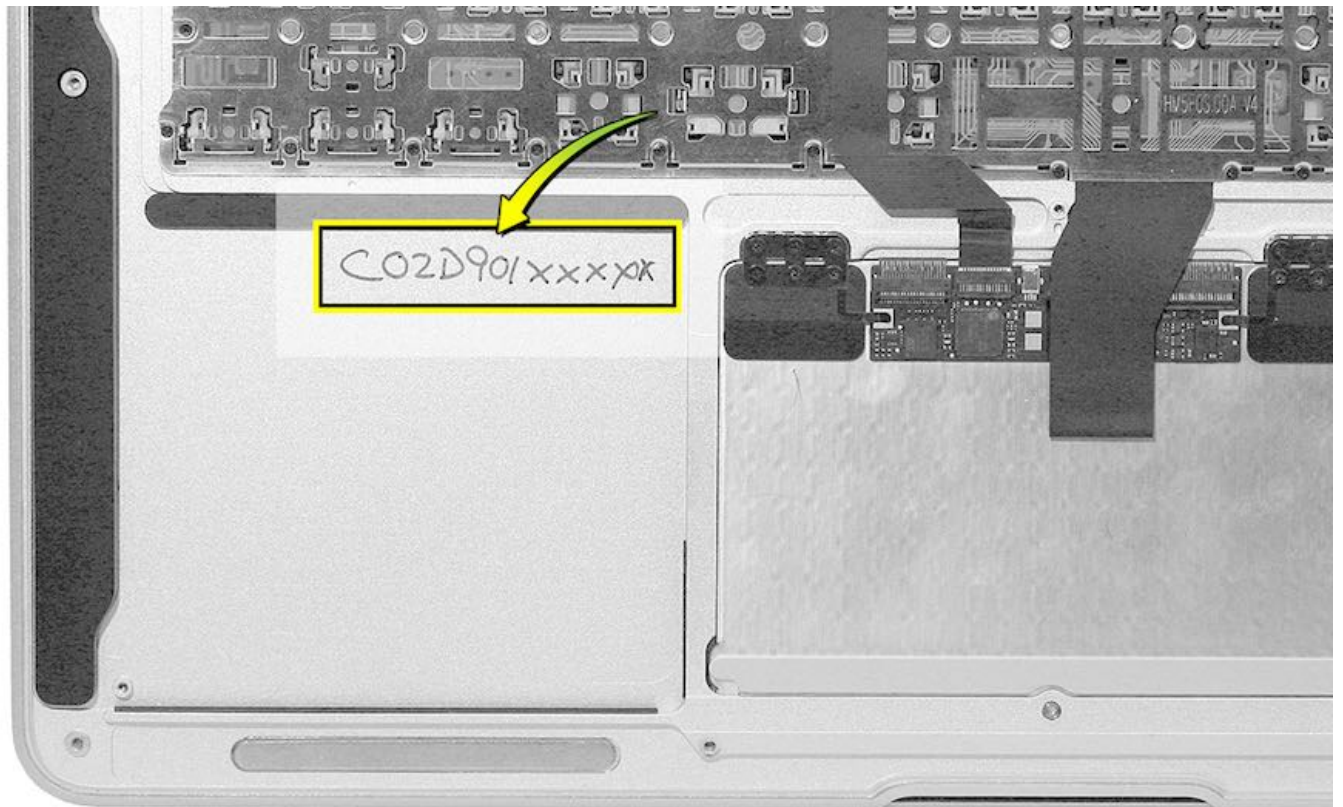
10. When installing replacement top case, retain original top case until repair is complete.

11. Before installing replacement top case, use heat gun and knife to lift up serial number label.

12. Transfer label to inside of replacement top case.



13. If label cannot be reused, use fine-tip permanent marker to write serial number on inside of top case.



14. Install left speaker. Use only a single layer of adhesive.

Important: For left speaker to fit properly in replacement 2011–2017 top case, it is especially important to clean off any adhesive or residual debris from bottom of speaker before installing. Replacement top case comes with adhesive pre-applied in strips to hold left speaker. Adhesive must lie flat in a single layer. Do not double up adhesive.

15. **Important:** After replacing a Mid 2013, Early 2014, Early 2015, or 2017 trackpad, you must use Trackpad Keyboard Mapper to ensure the trackpad is coded to match keyboard version.

- For Mid 2013 and Early 2014 models, refer to article [TP1016: AST Reference Guide: Using the Trackpad Keyboard Mapper](#).
- For Early 2015 and 2017 models, use the Trackpad Keyboard Mapper in AST 2. For more information about AST 2, refer to article [TP1105: AST 2 for Mac Reference Guide](#).

If the trackpad is replaced and not programmed using the Trackpad Keyboard Mapper tool:

- Only basic or generic keyboard functionality may be available
- The keyboard may not operate correctly
- The keyboard backlight function keys may not control the keyboard backlight brightness

Apple USB SuperDrive

First Steps

Important: The following procedure is intended only for removing a stuck disc from an Apple USB SuperDrive at the user's request. Do not take apart an Apple USB SuperDrive for repair. The repair strategy for this product is Whole Unit Replacement.

This procedure requires placing SuperDrive upside down on its top case. Always use a clean, debris-free static mat to avoid scratches and other cosmetic damage to the housing.



Tools

- ESD wrist strap and mat
- Black stick (922-5065)
- #000 Phillips screwdriver
- T10 Torx screwdriver (later models)
- Suction cup (922-8252)



Steps For Removal

Because this is a handheld procedure, perform these steps over a workbench or elevated repair surface to minimize height from which a component might fall.

1. Hold SuperDrive securely in one hand by edges of silver top case, with black bottom case facing up and USB cable leading away from you.



2. With other hand, place suction cup on center of bottom case. Press down firmly to flatten and secure suction cup.



3. Once suction cup is fully adhered, lift straight up. Pull bottom case directly out of top case in one smooth motion. Secure fit might give a lot of resistance.

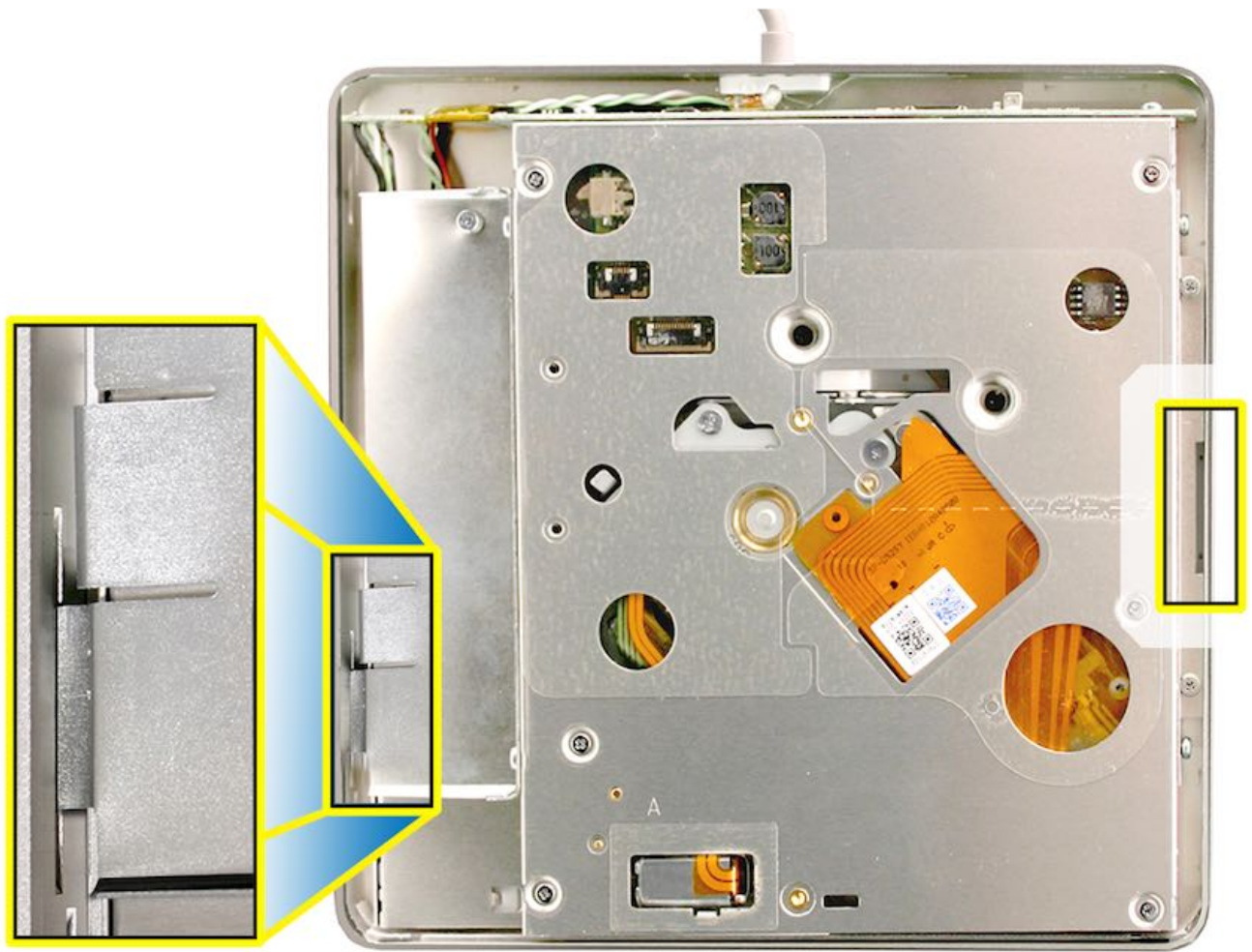
Important: Adhesion of suction cup is short-lived. To avoid damage from dropping, immediately set bottom case on a clean surface. Be mindful of tabs.



4. Set drive top-down on a soft, clean surface, with inside facing up and USB cable leading away from you. Remove three #000 Phillips screws (shown below).



5. Note tab on lower left of drive fits into recessed slit on inside edge of top case (see below left). On opposite side of drive, note gap in center of right edge of drive (see below right).



6. Insert flat edge of black stick into gap on right edge of drive. Carefully pivot edge upward slightly, just enough to slide drive a few millimeters right. Ease left tab out of top case.



7. Note internal cable leading to external USB cable. In earlier model you will see a controller board connected to cable (see inset below).

Caution: Since cable remains connected during this procedure, be careful not to pull or stress cable connections. To avoid

damaging cable, always keep drive within an inch or so of outer case.

8. Grip drive by edges. Avoid touching components. Lift drive up and out of top case a few millimeters — enough to pivot and flip drive over.



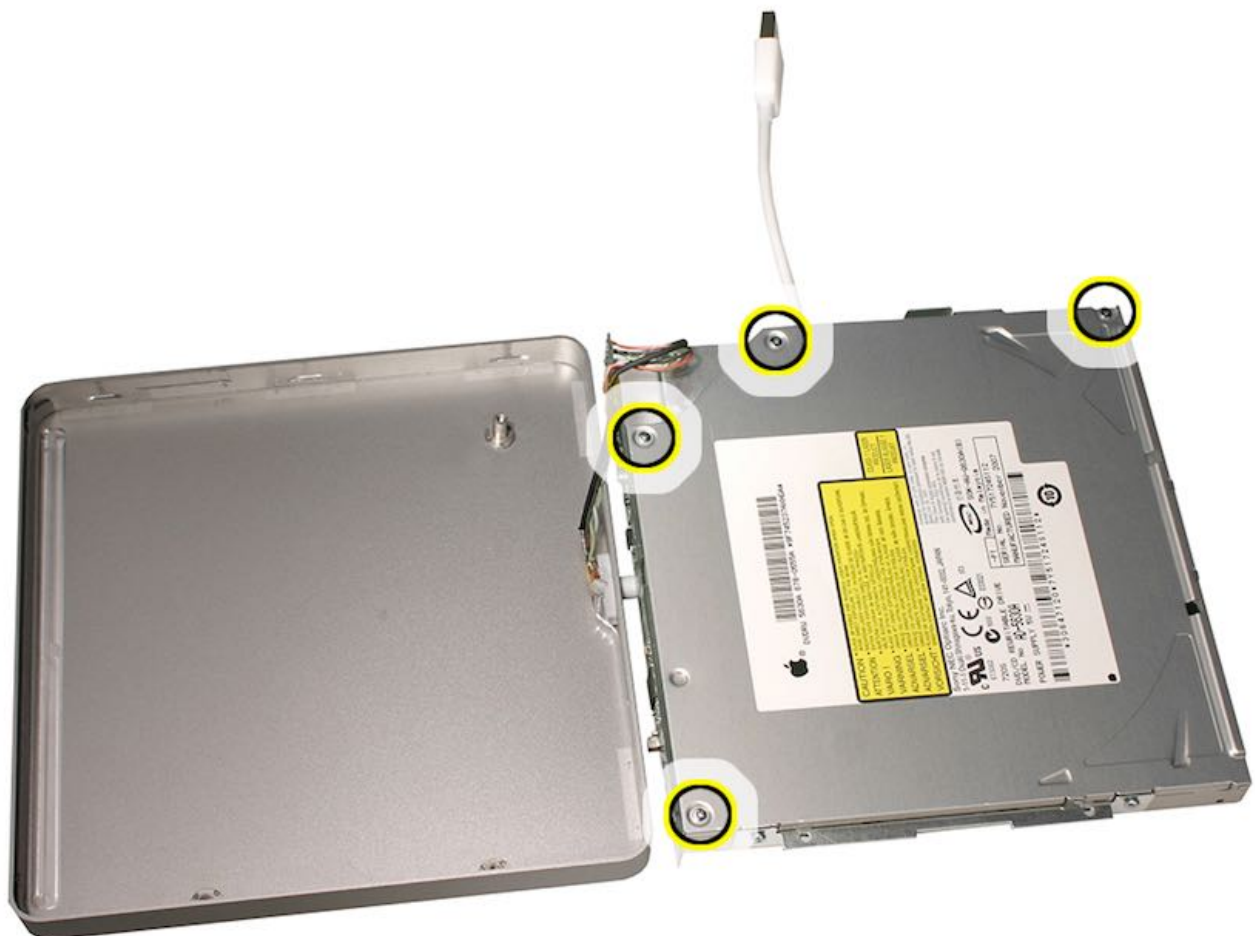
9. As if opening a book, flip drive up and over. Gently lay it down, keeping edges as close together as possible to avoid straining cable connections.



10. Immobilize drive while removing screws or components, holding drive by bracket or edges only.



11. Remove four #000 Phillips screws from top of drive (shown below).



12. Remove two T10 screws or two Phillips screws (depending on model) holding bracket to drive.

Earlier model:



Later models:



13. Lift top lid of drive, pivoting right edge up. Then shift lid left and downward to remove left edge.



14. Remove stuck disc. Reassemble SuperDrive in reverse order of previous steps 4-13. Proceed to step 15 to correctly reinstall bottom case.



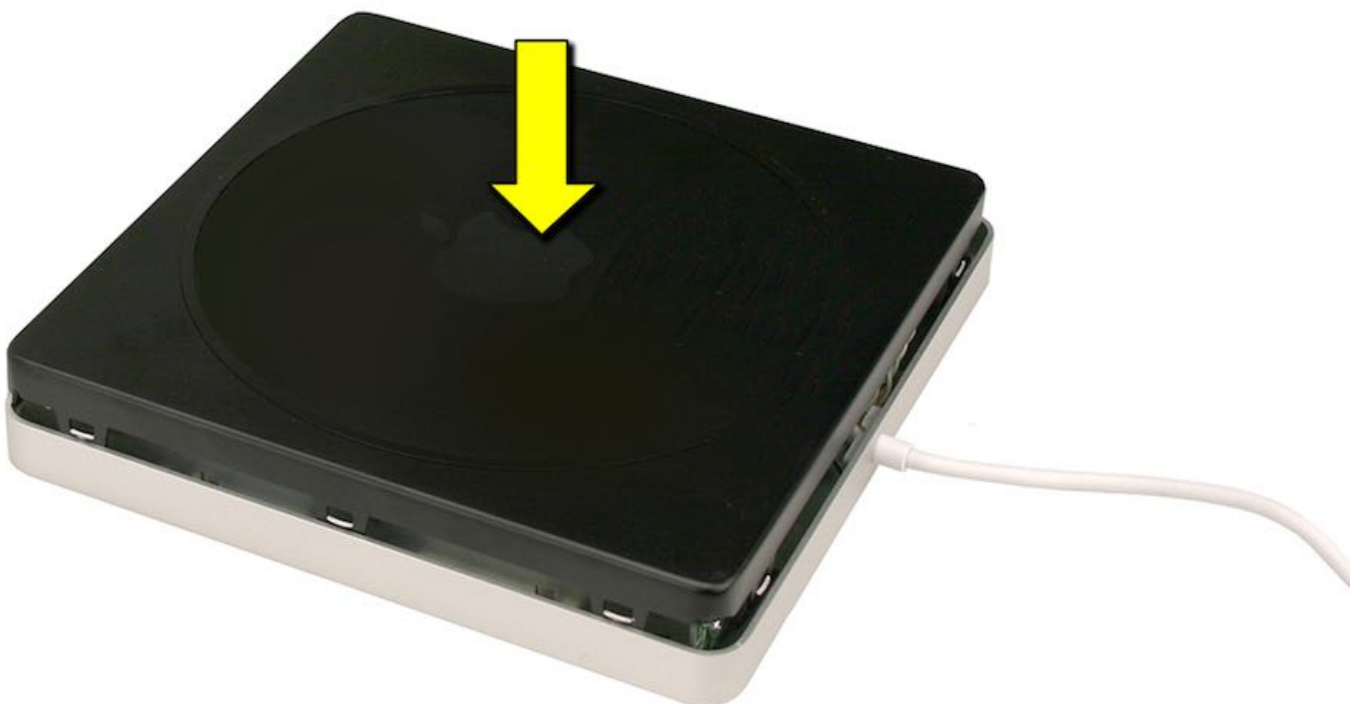
15. Orient bottom case to top case, as pictured below. Note three tabs per side on left and right sides of drive and two corner tabs in back. There are no tabs in front (where disc slot is located).



16. Set bottom case evenly on top case with tabs just inside perimeter of top case edge. Align all tabs with top case.

Note: If case is oriented correctly, Apple logo will be right-side up when USB cable is pointed toward you.

17. With firm, even pressure, snap bottom case into top case to seat tabs. Verify all tabs are fully seated and SuperDrive sits flat.



Steps For Reassembly

Reassemble in reverse order of removal steps.

Quick Test

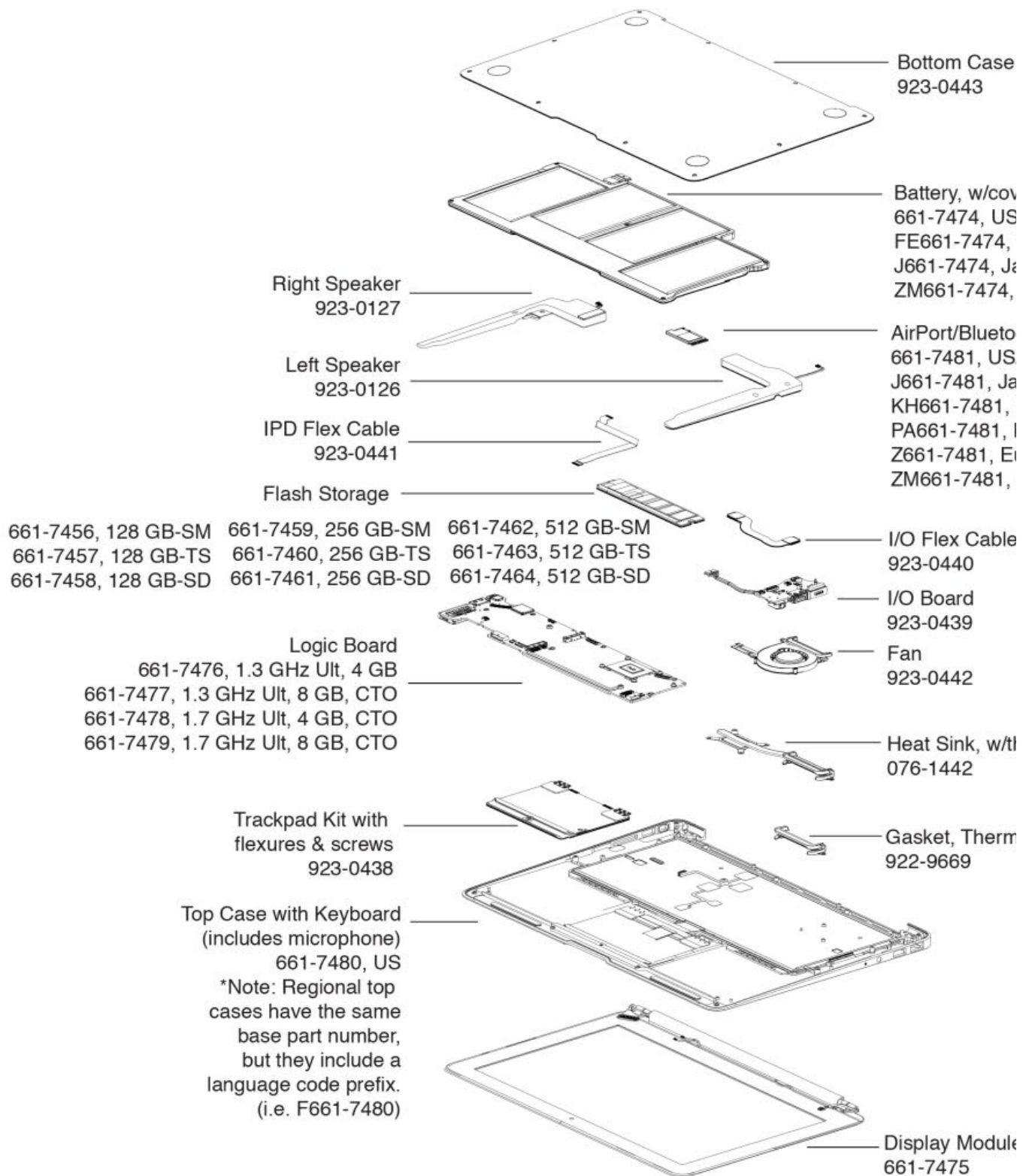
Plug Apple USB SuperDrive into known-good computer to check functionality. Check drive for disc insertion, mounting, and ejection of a variety of optical media.

Exploded View

This article contains the following sections:

- Exploded View for MacBook Air (13-inch, Mid 2013 and Early 2014)
- Exploded View for MacBook Air (13-inch, Early 2015 and 2017)

MacBook Air (13-inch, Mid 2013 and Early 2014)



Not Shown:

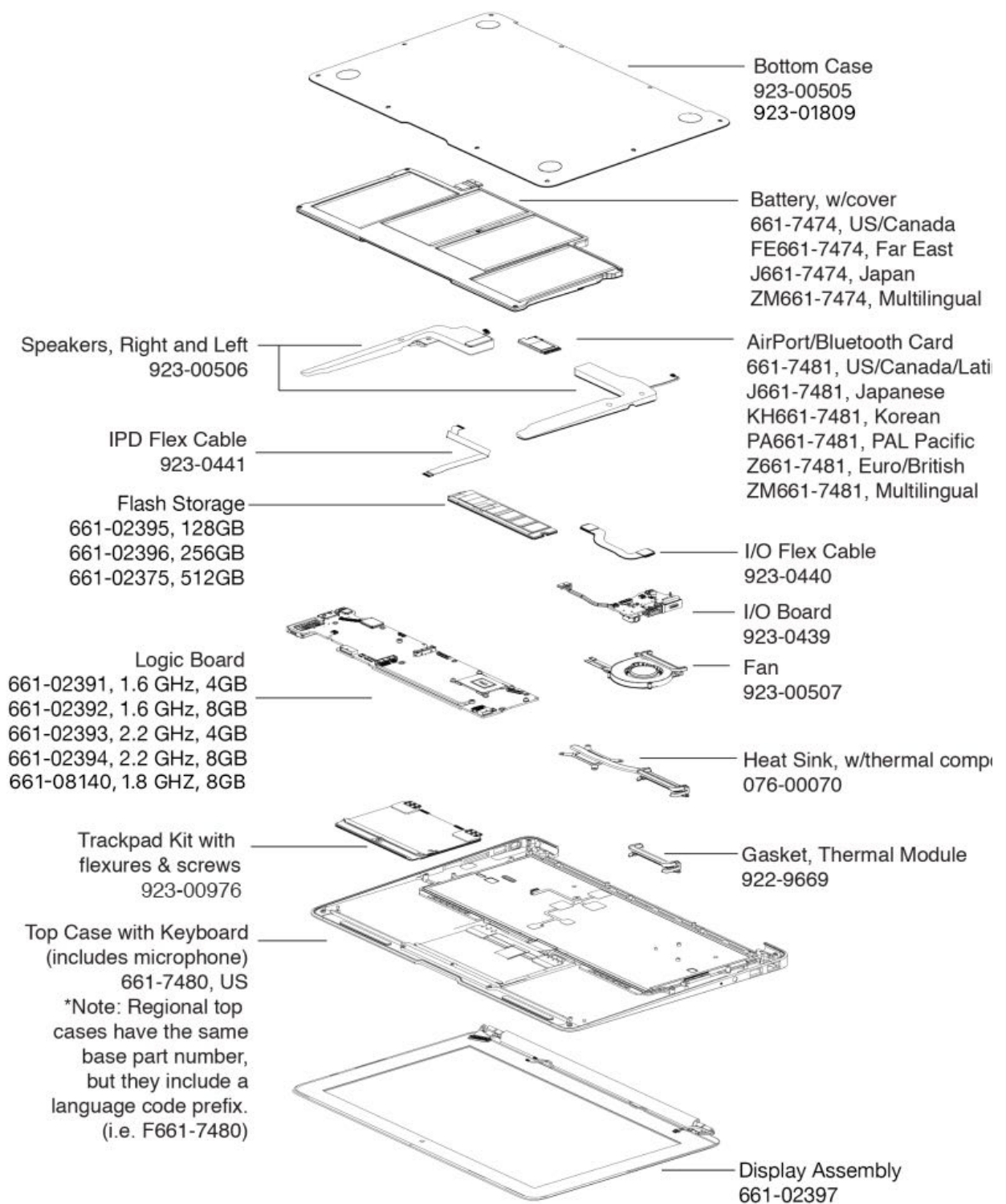
Clutch Barrel 076-1441

Battery Cover 922-9735

Thermal Compound, Syringe 922-7144

Power Adapter, 45W 661-7466; AR661-7466, Argentina; LA661-7466, Latin America; PA661-7466, Puerto Rico; ZM661-7466, Zanzibar
Kit, Pentalobe Screwdriver and Battery Covers 076-1372

MacBook Air (13-inch, Early 2015 and 2017)



Not Shown:

Clutch Barrel, 076-1441

Battery Cover, 922-9735

Thermal Compound, Syringe 922-7144

Power Adapter, 45W 661-00529; AR661-00529, Argentina; LA661-00529, Latin America; PA661-00529, PA
Kit, Pentalobe Screwdriver and Battery Covers 076-1372

Power Cord, 922-9173

Screw Chart

Screw Chart for MacBook Air (13-inch, Late 2010, Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017)

922-9651 Torx T5  Solid State Drive (1) Wireless Card (1)	922-9652 Torx T8  Display Clutch Hinge (6)	922-9653 Torx T5  Heat Sink Late 2010 (8) Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017 (4)
922-9654 Torx T5  Battery Late 2010 (top, center) (3) Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017 (center) (1)	922-9655 Torx T5  Heat Sink to Top Case (1) Battery (2) Late 2010, Mid 2013, Early 2014, Early 2015, 2017	922-9656 Torx T5  Logic Board (6) I/O Board (1)
922-9657 Torx T5  Fan (under I/O cable) (1) Battery (2) Mid 2011 and Mid 2012	922-9658 Phillips #000  Trackpad flexure (6)	922-9659 Pentalobe  Bottom Case (2) Late 2010

922-9661 Torx T5  Fan to Logic Board (1) Speakers (1) Late 2010	922-9660 Torx T5  Fan to I/O Board (1)	922-9685 Pentalobe  Bottom Case (8) Late 2010 and Mid 2011
922-9732 Torx T5  Trackpad (set screw) (1)	922-9755 Pentalobe  Bottom Case (2) Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015	922-9969 Torx T5  Battery (top sides) (2) Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017
923-0122 Pentalobe  Bottom Case (8) Mid 2012, Mid 2013, Early 2014, Early 2015, 2017	923-00511 Torx T5  Heat Sink (4) Early 2015, 2017	

Screw Location Diagrams

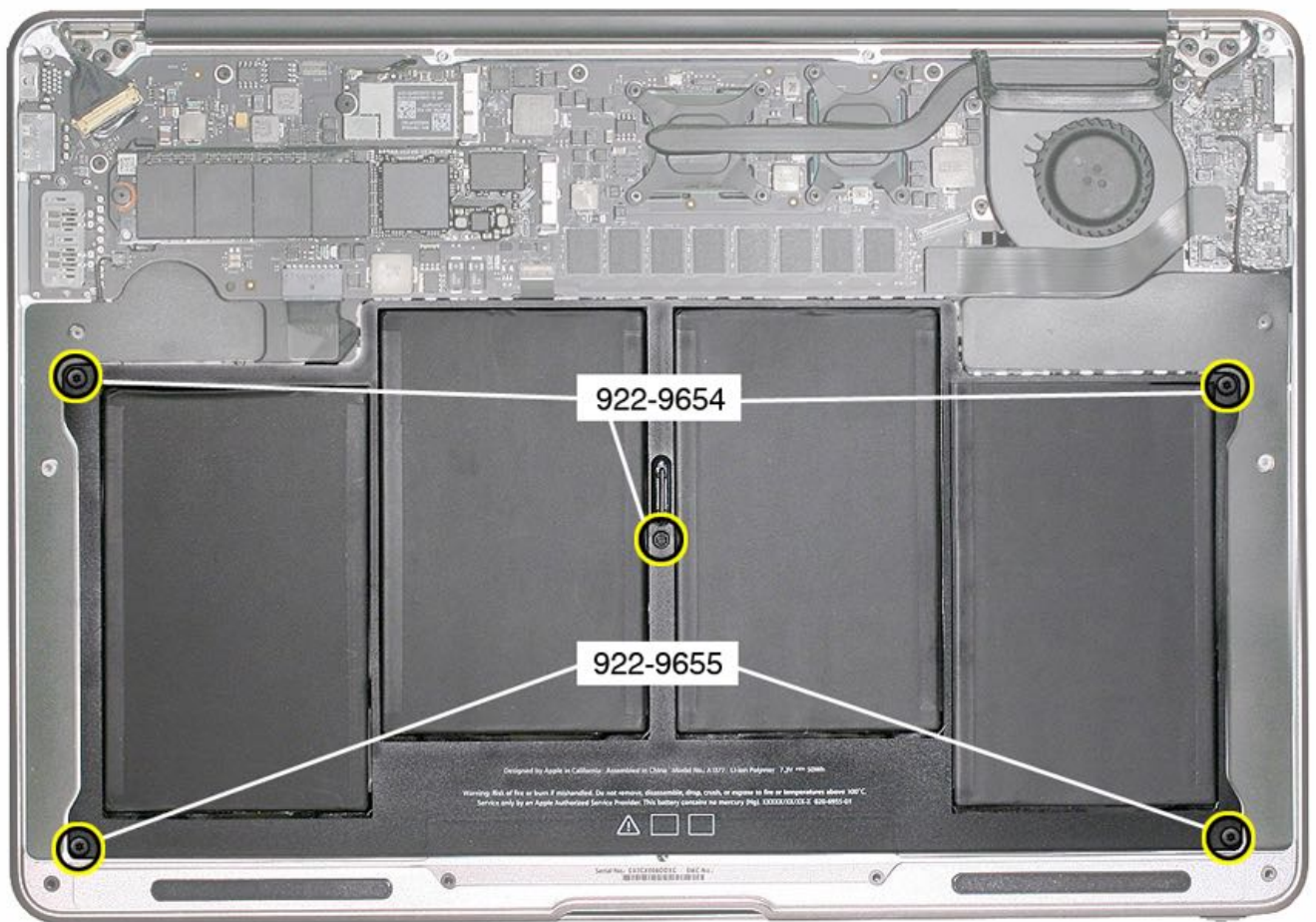
Screw Location Diagrams for MacBook Air (13-inch, Late 2010, Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017)

Bottom Case

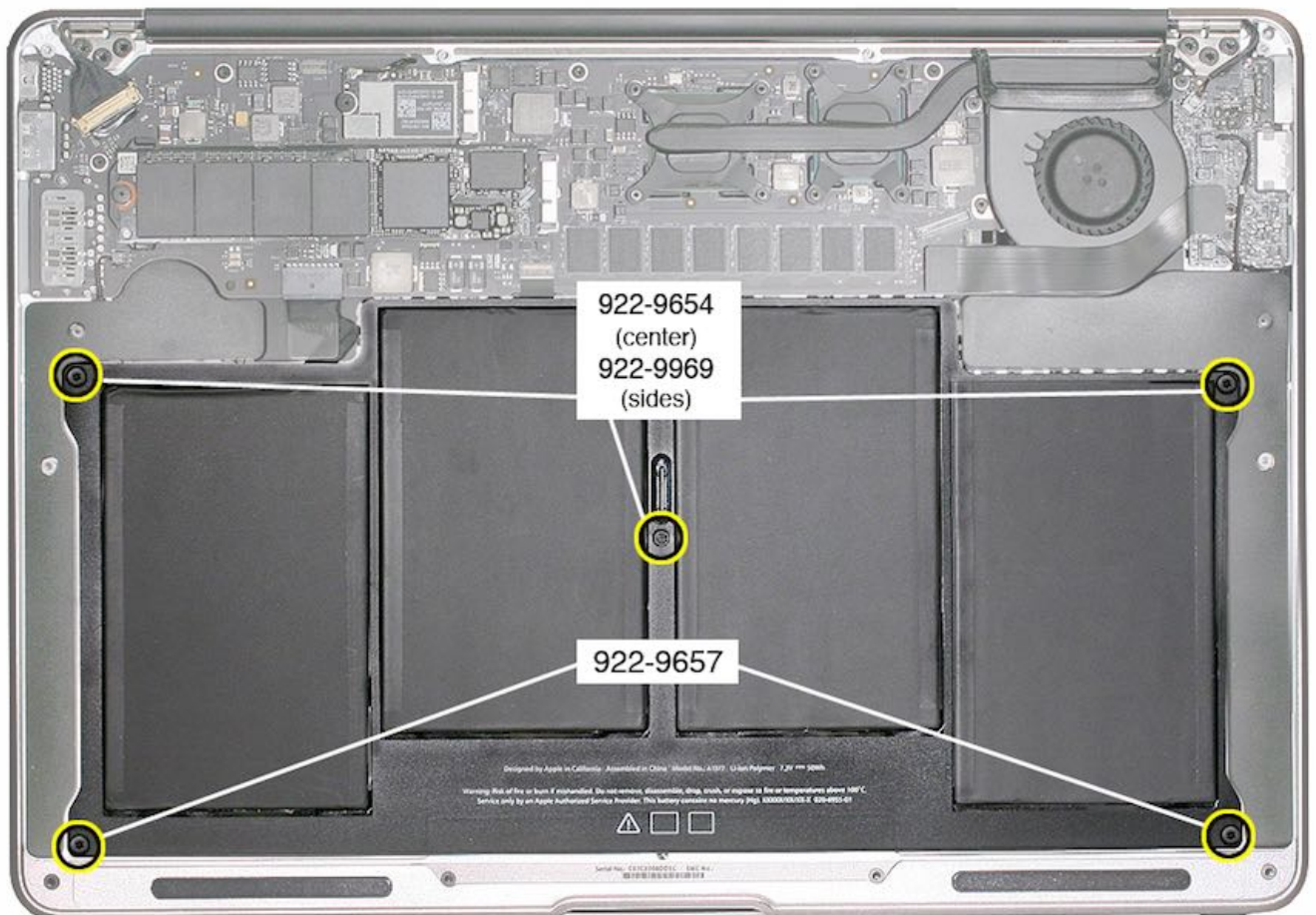
Note: Every screw labeled for 2013 also applies to the Early 2014 and later models.



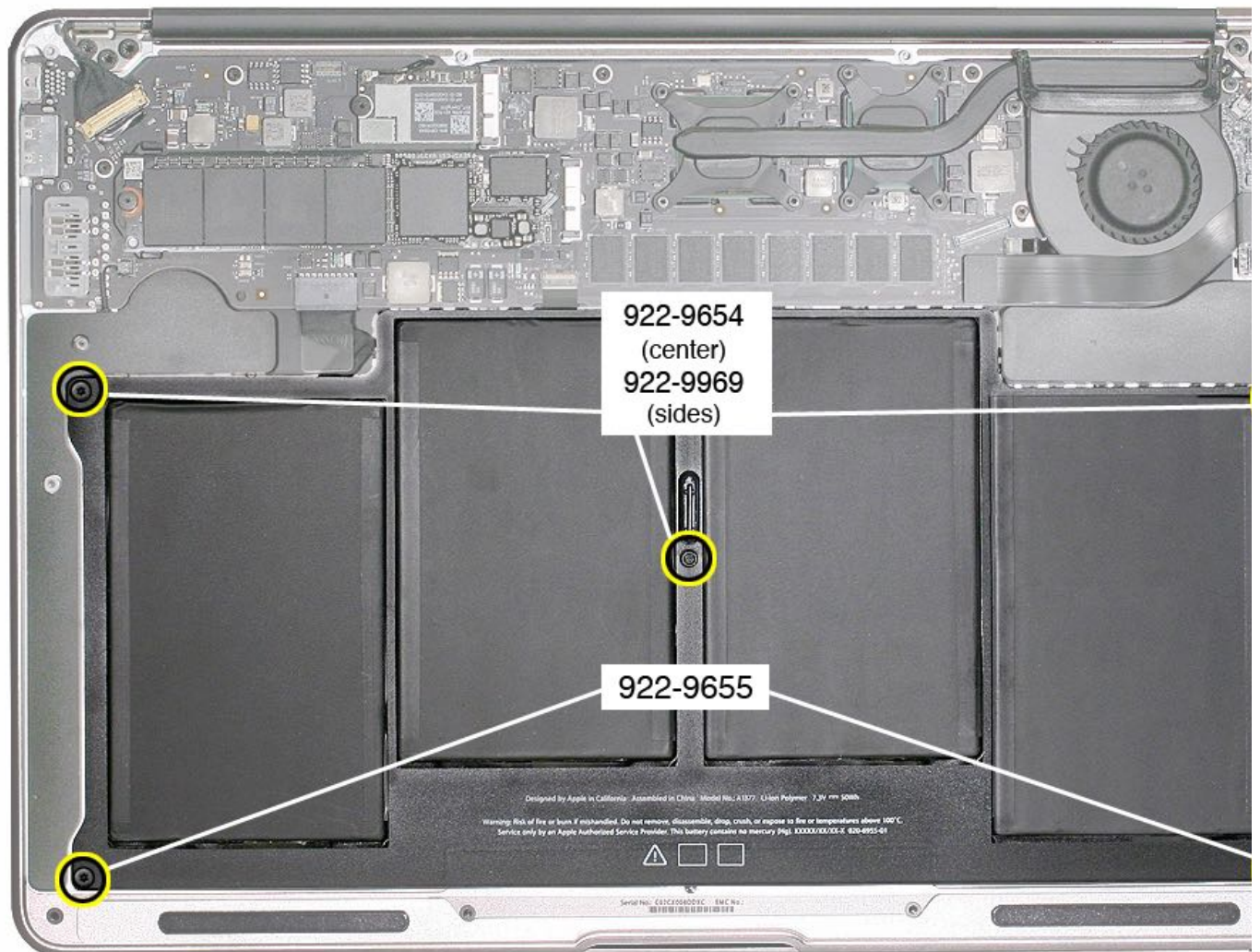
Battery, Late 2010



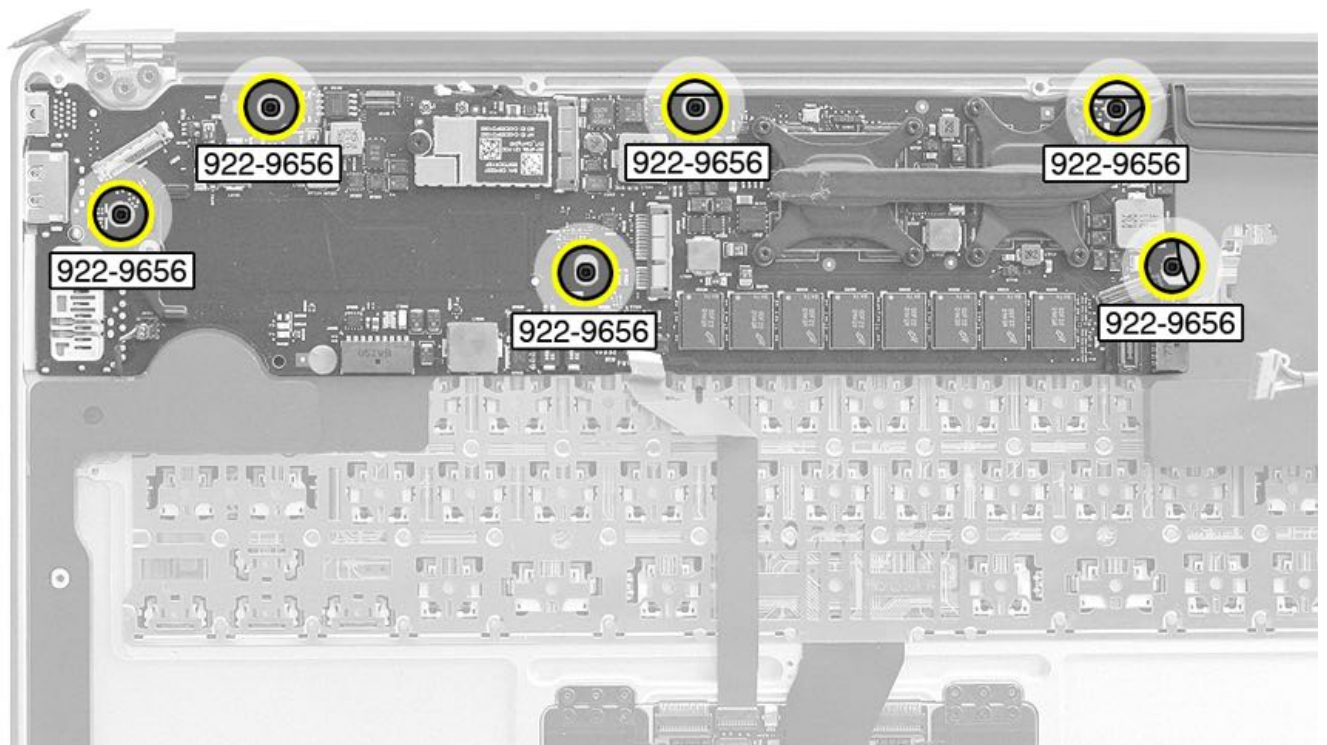
Battery, Mid 2011 and Mid 2012



Battery, Mid 2013, Early 2014, Early 2015, 2017

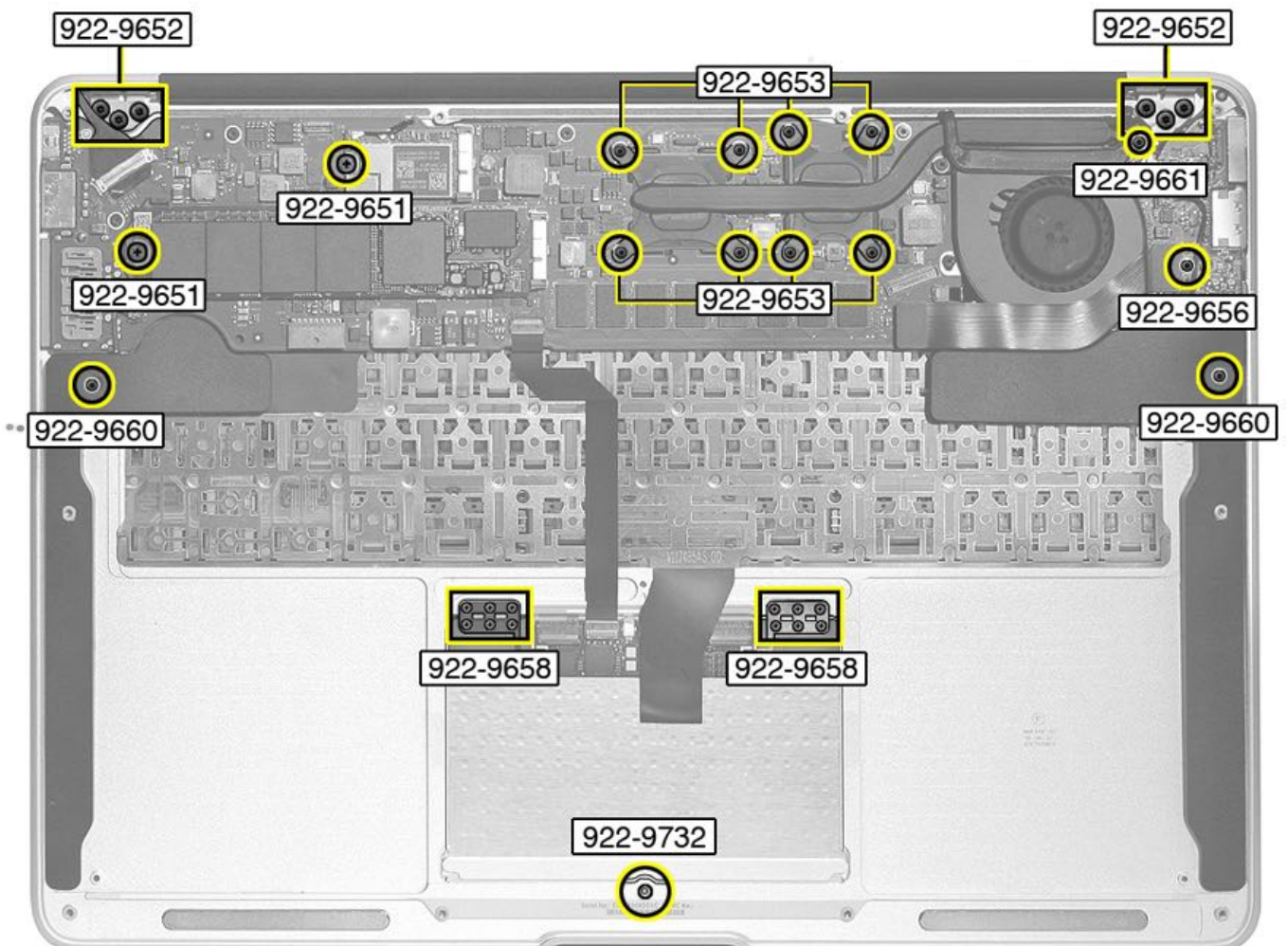


Logic Board



Speakers, I/O Board, Display Clamshell, Heat Sink, SSD Card or Flash Storage, AirPort/Bluetooth Card, Trackpad

Note: MacBook Air (13-inch, Early 2015 and 2017) heat sink screws are 923-00511.



External Views

External Views for MacBook Air (13-inch, Late 2010, Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017)

Front View



Port View

Late 2010, Mid 2011, and Mid 2012



Mid 2013, Early 2014, Early 2015, 2017



Late 2010



Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017



A = MagSafe (Late 2010 and Mid 2011) or MagSafe 2 (Mid 2012, Mid 2013, Early 2014, Early 2015, 2017)

B = USB 2.0 (Late 2010 and Mid 2011) or USB 3 (Mid 2012, Mid 2013, Early 2014, Early 2015, 2017)

C = Headphone (audio out)

D = Microphone

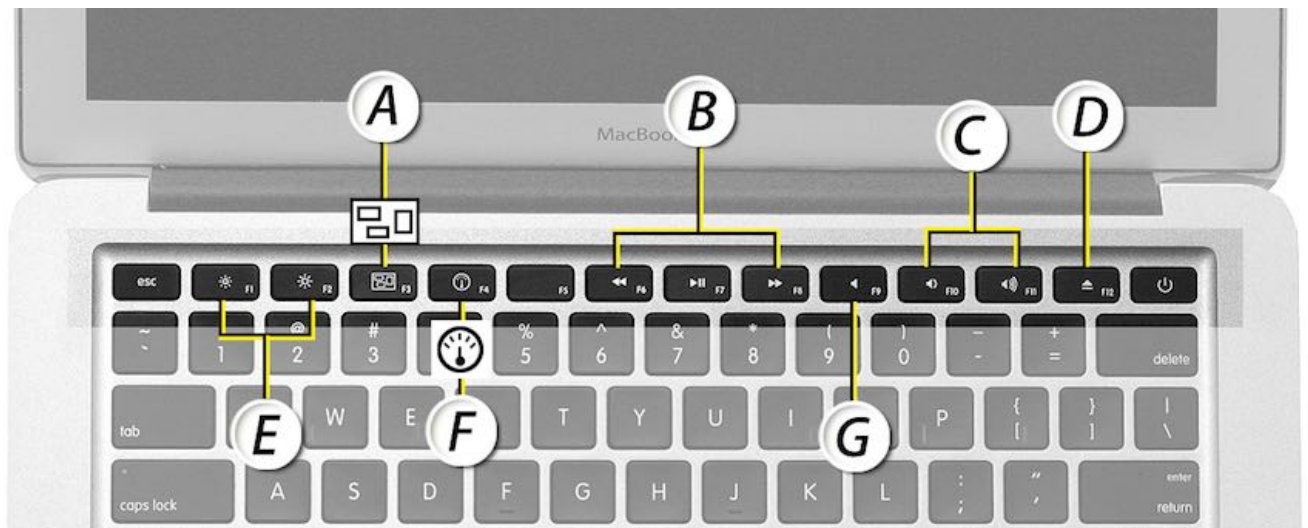
E = SD Card Slot

F = USB 2.0 (Late 2010 and Mid 2011) or USB 3 (Mid 2012, Mid 2013, Early 2014, Early 2015, 2017)

G = Mini DisplayPort (Late 2010); Thunderbolt (Mid 2011, Mid 2012, Mid 2013, Early 2014); Thunderbolt 2 (Early 2015 and 2017)

Function Keys

Late 2010



A = Exposé key

B = Media keys

C = Volume keys

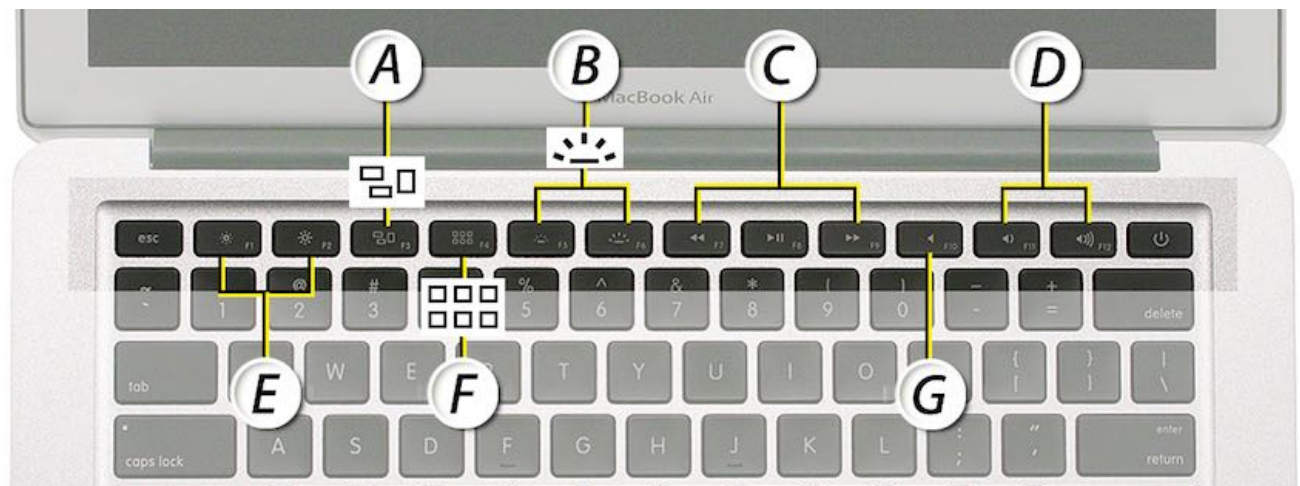
D = Media Eject key

E = Brightness keys

F = Dashboard key

G = Mute key

Mid 2011, Mid 2012, Mid 2013, Early 2014, Early 2015, 2017



A = Mission Control key

B = Keyboard illumination keys

C = Media keys

D = Volume keys

E = Brightness keys

F = Launchpad key

G = Mute key

MagSafe 2 45W Power Adapter

MagSafe 2 Power Adapter

The MacBook Air (11-inch and 13-inch, Mid 2012, Mid 2013, Early 2014, Early 2015) and MacBook Air (13-inch, 2017) feature a 45W MagSafe 2 power adapter. The MagSafe 2 connector is different from the MacBook Air (Late 2010 and Mid 2011) MagSafe connector. The MagSafe 2 power adapter is not backward compatible.



MagSafe 2 Power Connector



MagSafe to MagSafe 2 Converter

The MagSafe to MagSafe 2 Converter allows you to use the MagSafe connector on your LED Cinema Display, Thunderbolt Display, or MagSafe Power Adapter to charge your MagSafe 2-equipped Mac computer.



MagSafe 2 and MagSafe Port Comparison

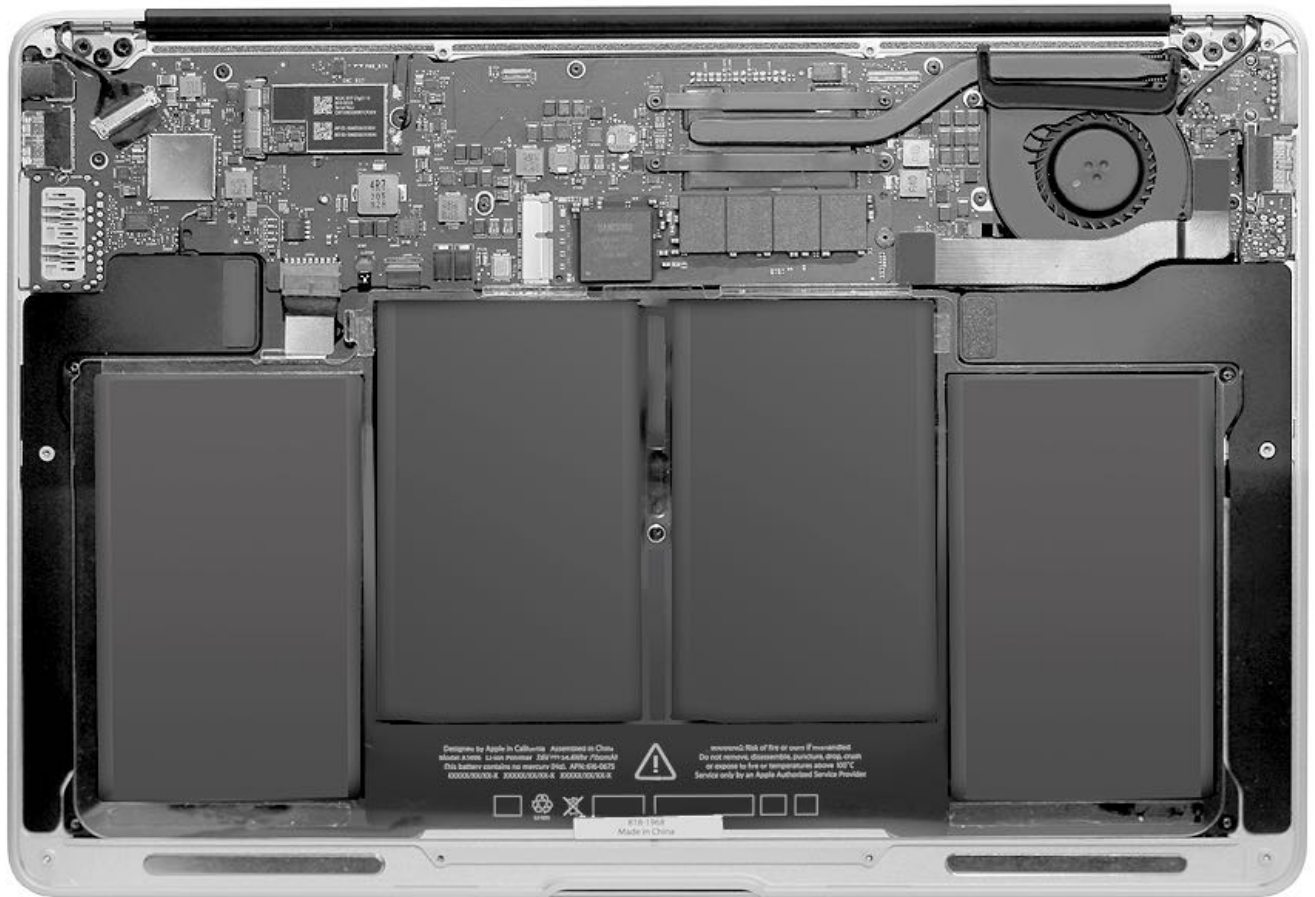
The image below shows the difference between the MacBook Air (11-inch and 13-inch, Mid 2012 and later) MagSafe 2 port and the MagSafe port on the MacBook Pro (second image).



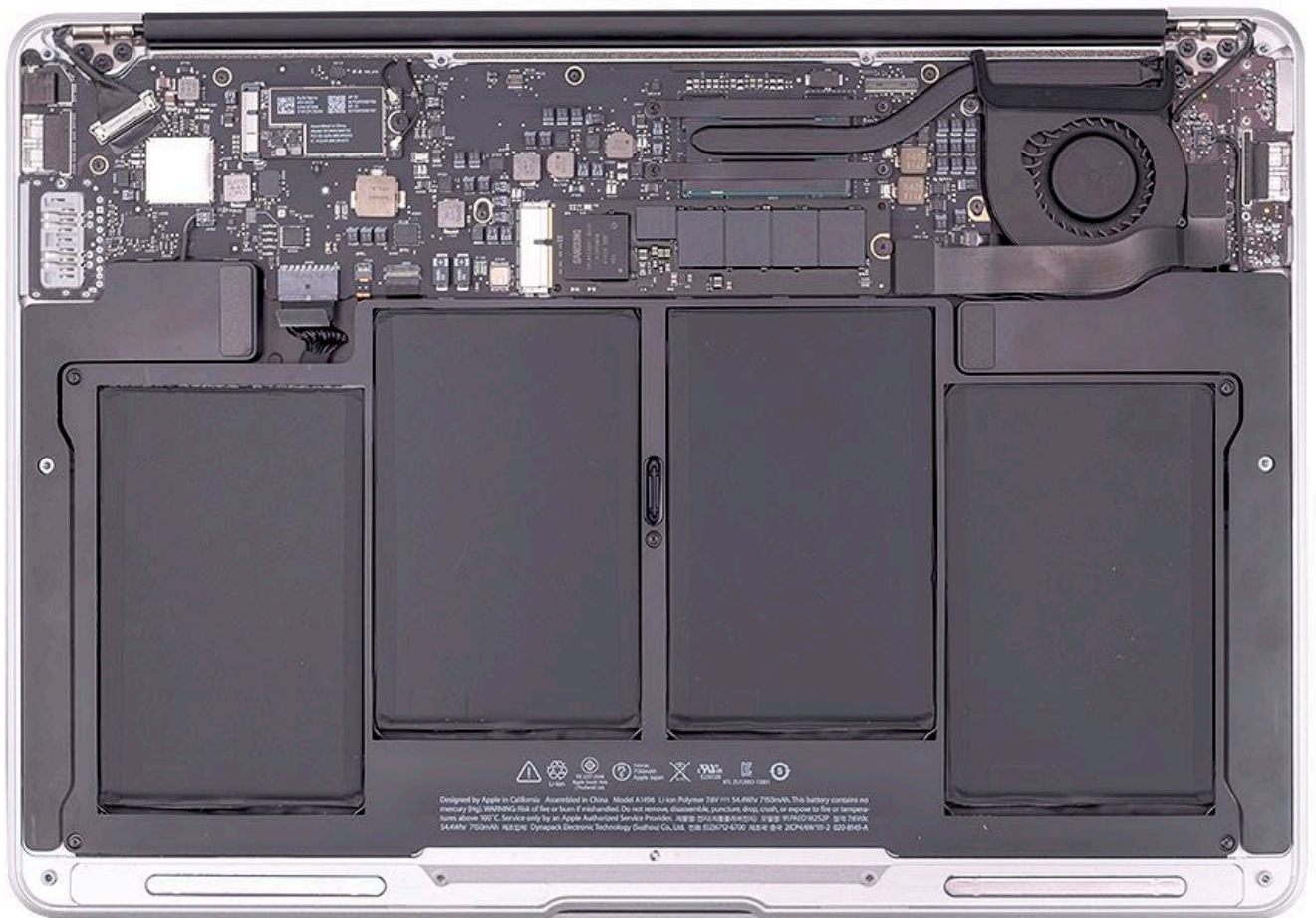
Internal View

Bottom Case Removed

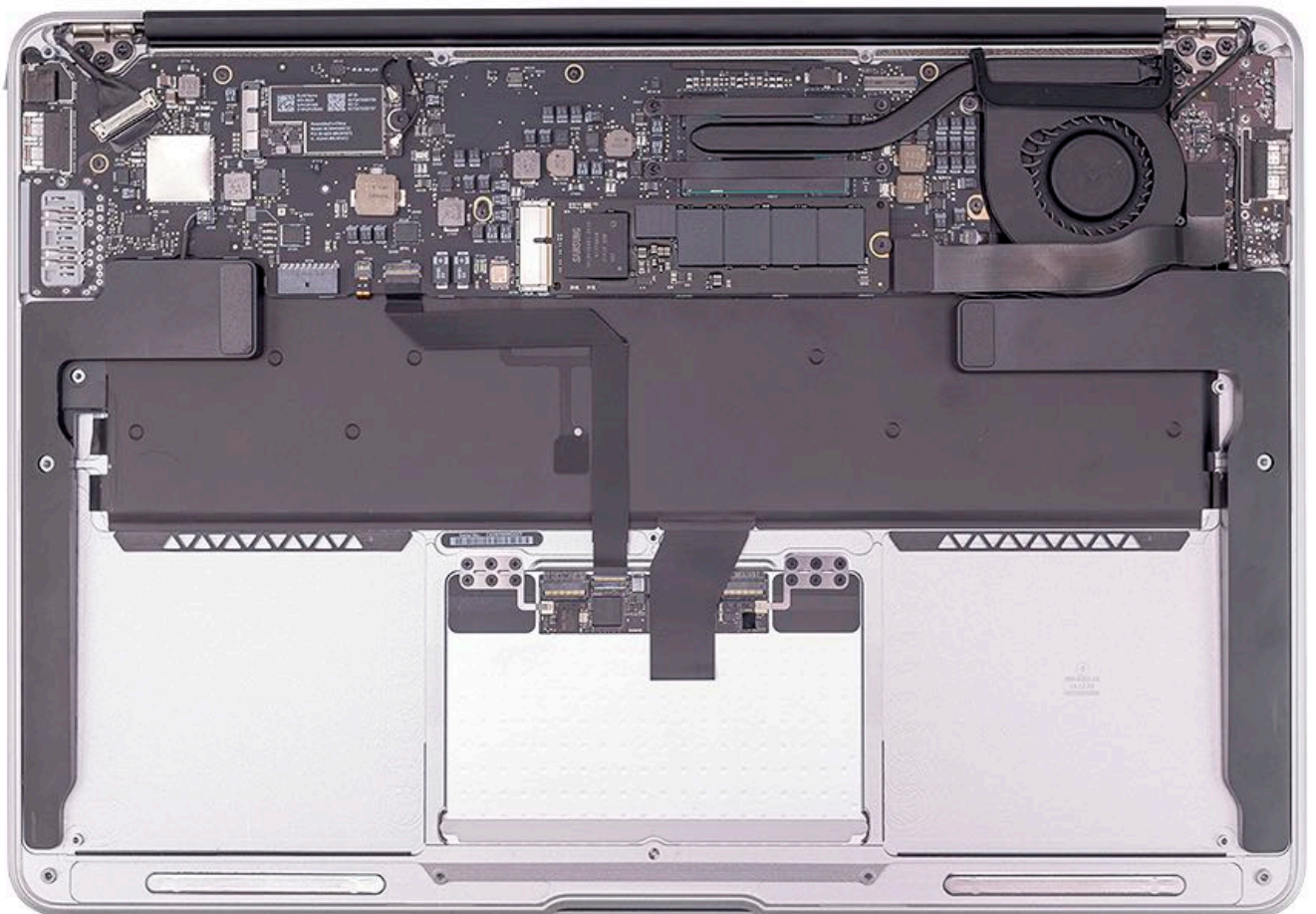
MacBook Air (13-inch, Mid 2013 and Early 2014)



MacBook Air (13-inch, Early 2015 and 2017)



MacBook Air (13-inch, Early 2015 and 2017) with battery removed



Service Content Feedback

This escalation path is intended only for content issues with articles that begin with the prefixes listed below.

Article prefix	Escalate to
IT	itsflows@group.apple.com
OP, RS, SN	srvcomms@group.apple.com
RP, SD, SM, TP	serviceguides@group.apple.com
SV	servicevideos@group.apple.com

Please provide a clear and concise description of the content issue you encountered and steps to reproduce. Other information that helps us help you:

- Article number(s) and titles
- Serial number(s)
- Screenshots or screen recording

Note: You may not receive a response, but all comments will be reviewed and investigated as needed.